THE AEROPLANE and ASTRONAUTICS

SEPTEMBER 21, 1961

EVERY THURSDAY
ONE SHILLING
AND SIXPENCE

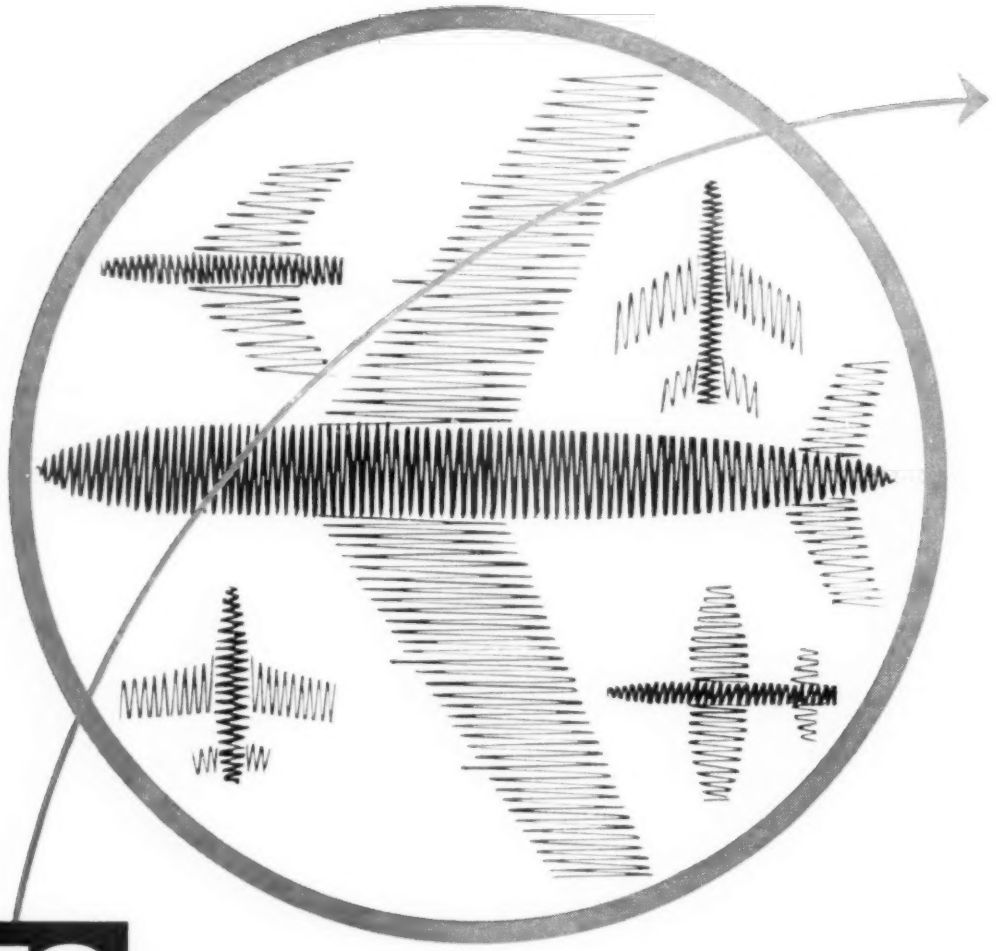
SPEY BY-PASS JETS

ROLLS-ROYCE

SPEY BY-PASS JETS WILL POWER TWO NEW JET TRANSPORTS AND A STRIKE AIRCR

DE HAVILLAND TRIDENT · B.A.C. ONE-ELEVEN · BLACKBURN BUCCANEER

AERO ENGINES · MOTOR CARS · DIESEL AND PETROL ENGINES · ROCKET MOTORS · NUCLEAR PROPUL



STC

radio interference suppressors for high temperature operation

A range of STC Suppressors employing metallised Melinex dielectrics, capable of operation at 125° C and 150° C, to suit the following aircraft applications:-

- **ENGINE ELECTRICAL EQUIPMENT**
- **MAIN POWER GENERATING SYSTEMS**
- **SHORT TERM RATED MOTORS**
- **POWER SYSTEMS CONTROL EQUIPMENT**

Among the aircraft for which STC Suppressors are specified are:-

COMET IV	**VANGUARD**
BRITANNIA	**CANBERRA**
VISCOUNT	**TWIN PIONEER**
HUNTER	**P.1.**
192 HELICOPTER	**WESSEX HELICOPTER**

RADIO INTERFERENCE MEASUREMENT SERVICE

The STC Radio Interference Measurement Service Department is approved by the Ministry of Aviation and the Air Registration Board for type testing of electrical equipment for Radio Interference and also for the design and development of suppressors and suppressor networks to the requirements of B.S.G. 100 and E.L. 1716, Section J.

Write for details of STC Interference Suppressors to:-

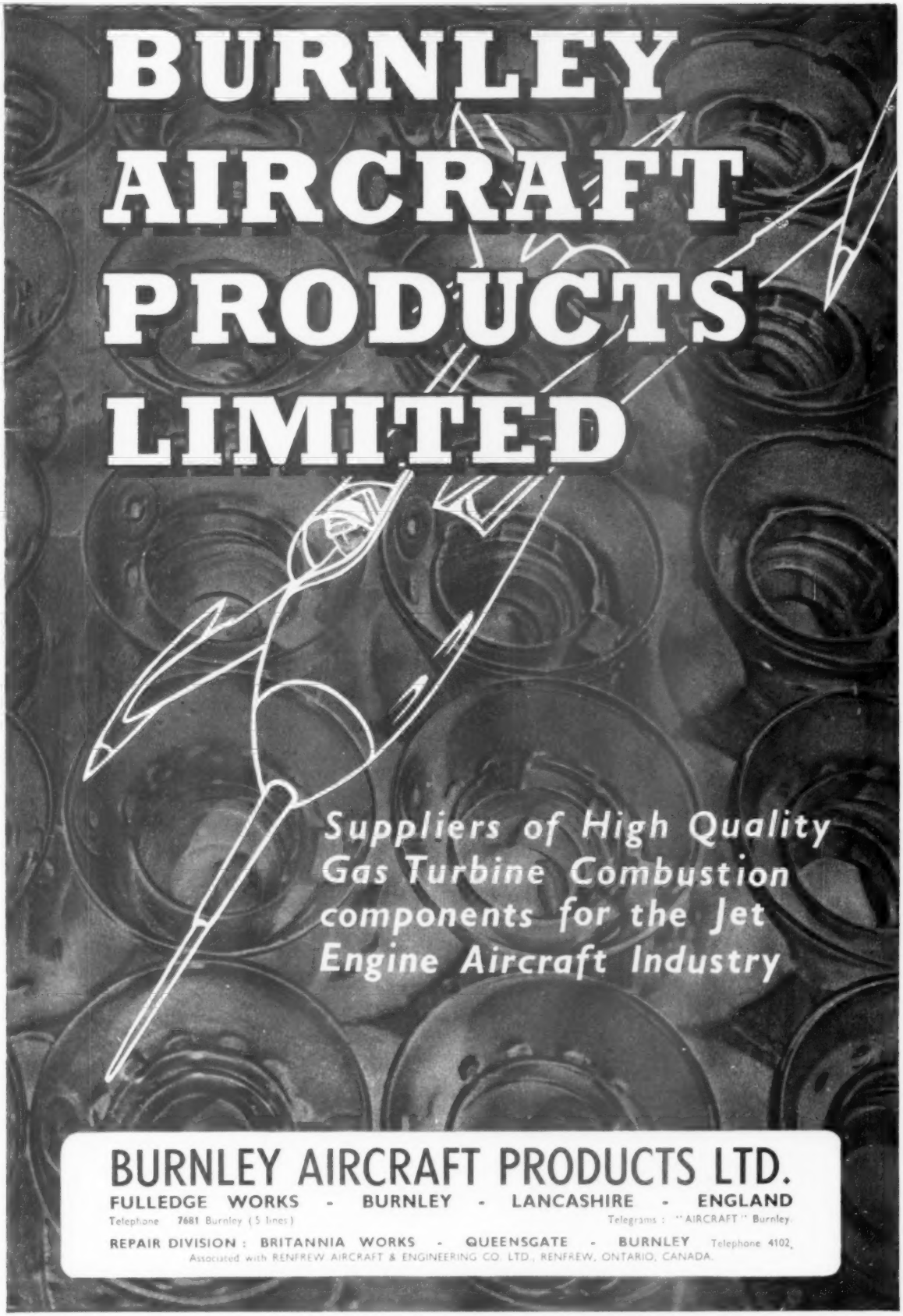
COMPONENTS GROUP

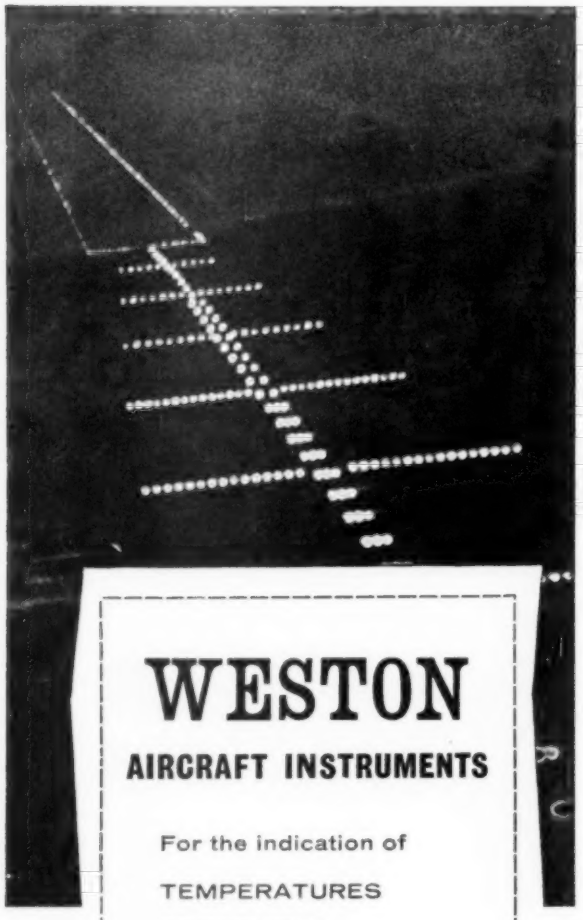
60.5MC

Standard Telephones and Cables Limited

CAPACITOR DIVISION: BRIXHAM ROAD · PAIGNTON · DEVON

Second class postage paid at New York, N.Y.


BURNLEY
AIRCRAFT
PRODUCTS
LIMITED
Suppliers of High Quality
Gas Turbine Combustion
components for the Jet
Engine Aircraft Industry
BURNLEY AIRCRAFT PRODUCTS LTD.
FULLEDGE WORKS - BURNLEY - LANCASHIRE - ENGLAND
Telephone 7681 Burnley (5 lines)
Telegrams: "AIRCRAFT" Burnley
REPAIR DIVISION: BRITANNIA WORKS - QUEENSGATE - BURNLEY Telephone 4102
Associated with RENFREW AIRCRAFT & ENGINEERING CO. LTD., RENFREW, ONTARIO, CANADA.



WESTON

AIRCRAFT INSTRUMENTS

For the indication of

TEMPERATURES

PRESSURES

CONTROL SURFACE POSITIONS

TURBINE SPEEDS

ELECTRICAL POWER

ALSO: Navigational Aids*
Ground Test Sets
Ice Warning Systems · Relays etc.

*Model S178 Hermetically sealed miniature homing indicator.

SANGAMO WESTON LIMITED
ENFIELD · MIDDLESEX

Tel: Enfield 3434 (6 lines) & 1242 (6 lines) Grams: Sanwest, Enfield.
Scottish Factory, Port Glasgow, Renfrewshire, Port Glasgow 41151.
Branches:
London · Glasgow · Manchester · Newcastle-on-Tyne
Wolverhampton · Nottingham · Bristol · Southampton

SANGAMO WESTON

HAWKER SIDDELEY AVIATION

We invite applications from experienced and qualified structures engineers for the post of

Chief Stressman

at our

LONDON DESIGN OFFICE

This is a senior position and applicants must have previous aircraft experience plus the ability to manage a team.

Please write to:
The Designer-in-Charge,
BLACKBURN AIRCRAFT LIMITED,
63 Old Brompton Road, South Kensington

BLACKBURN AIRCRAFT LIMITED

BRITISH OVERSEAS AIRWAYS CORPORATION

OFFERS FOR SALE

THREE DOUGLAS DC-7C AIRCRAFT

★ Choice of interior configurations
★ Current Certificates of Airworthiness
★ Immediate delivery
★ Supporting spares available

Further information obtainable from :—
Manager, Aircraft Sales, B.O.A.C., Building 209, London Airport, Hounslow, Middx. Phone: Skyport 5511, Ext. 2404

BELFAST

- Greater mobility for a greater armed force than ever before.
- Cargo hold 12′ x 12′ x 64′ Rolls-Royce Tyne turbo-props. From 40 tons for 1,000 miles to 15 tons for 4,000 miles.
- Ordered for the Royal Air Force, the strategic BELFAST can carry the heaviest and bulkiest equipment in service.
- Tactical variants are being designed with shorter take-off and landing, but with fuselage unchanged from the strategic-freighter — outstanding advantage where aircraft operate in complementary roles.
- The BELFAST offers new possibilities for strategic and tactical planning.

SHORT BROTHERS & HARLAND LTD

LONDON · BELFAST · ROCHESTER

For the first time England to Australia non-stop . . . by Avro Vulcan

HAWKER SIDDELEY AVIATION

32, Duke St., St. James's, London S.W.1

THE AEROPLANE and ASTRONAUTICS

VOLUME 101 NUMBER 2605 SEPTEMBER 21, 1961

Students at the Show

A Commonwealth student, attending a British University, has raised a matter of some importance. Like many others of his age group he had dreamed for years of getting to this country to study aeronautical engineering, and also of visiting the S.B.A.C. Show at Farnborough. In spite of gathering that the public days were real "bun fights," he did not doubt that there would be arrangements for students to go, and particularly aeronautical students from overseas, as to him this seemed to be in the best interests of the manufacturers as well as the students.

As a student member of the Royal Aeronautical Society he wrote to the secretary last year, inquiring about a ticket for one of the trade days, and was duly informed that his letter had been forwarded to the S.B.A.C. He heard no more and told us that it was only through a great stroke of luck that he was finally able to visit Farnborough.

This year he contented himself with going on a public day but wrote to raise the problem with us. Clearly, it would not be fair to raise this particular application with the S.B.A.C. after so long a delay. However, the point raised by our correspondent poses an important question regarding students at the Farnborough Show. Mind you, one has only to go on the "preview" Monday to see how well the technicians of the industry do patronize the Show. One wonders how many students do get in on that day.

In the first instance, it seems that fundamentally the question is one for the Royal Aeronautical Society to make up its mind about before taking up the question with the Society of British Aircraft Constructors.

A Three-party Symposium?

One of the matters left unresolved at the conclusion of the eighth Anglo-American Aeronautical Conference last week concerned the likely venue for the ninth Conference in the series which will be held two years' hence. Following the established custom of alternating these events between the U.S.A. and the U.K., the 1963 Conference should be held in America. Indeed, it was suggested by the president of the Institute of the Aerospace Sciences, in his speech at the end-of-conference dinner, that Boston would be most suitable; it was on the eastern seaboard and close to the Canadian border.

There appears, however, to be some strong body of opinion that would like to see the next Conference actually in Canada. This point was informally raised during a small dinner party in London at which the C.A.I. president, Air Cdre. W. P. Gouin, and its secretary, H. C. Luttman, entertained some two dozen overseas members of the Institute.

Certainly, we can imagine, such a proposal would meet with widespread approval. Our friends in Canada need have no fear that their own Canadian Aeronautical Institute would not make excellent hosts. Indeed, such a move would do much to widen the scope and value of the Conference and strengthen the aeronautical ties within the Commonwealth.

Editor - - - - - THURSTAN JAMES
Deputy Editor - - - - F. T. MEACOCK

Founder Editor (1911-1939) C. G. Grey

Proprietors - - TEMPLE PRESS LIMITED
Chairman and Managing Director
ROLAND E. DANGERFIELD

Editorial, Advertisement and Publishing Offices:
BOWLING GREEN LANE, LONDON, E.C.1

Telephone: TERminus 3636
Telegrams: "Pressimus London Telex"
Telex: 23839

Annual Subscription Rate: United Kingdom £4 15 0
Overseas £5. Canada and U.S.A. $15.00

© Temple Press Limited, 1961. The proprietors will consider any written requests to reproduce articles and illustrations appearing in this journal. Comment and brief extracts which acknowledge *The Aeroplane and Astronautics* are permissible.

Matters of Moment

B.A.C. Executive Changes

REORGANIZATION among the higher executive of the British Aircraft Corporation, was announced last week. From Oct. 1, Sir George Edwards, C.B.E., B.Sc., Hon.F.R.Ae.S., Hon. F.I.A.S., who has been executive director (aircraft) of the Corporation since its formation in May last year, will be its managing director. At the same time he will become deputy chairman of Vickers-Armstrongs (Aircraft), Ltd., and will give up his responsibilities as managing director of that company.

The Rt. Hon. Viscount Caldecote, D.S.C., M.I.Mech.E., M.I.E.E., A.F.R.Ae.S., at present B.A.C. executive director (guided weapons), has been appointed deputy managing director of the Corporation and chief executive (guided weapons).

Another principal appointment in the Corporation's executive is that of Marshal of the Royal Air Force Sir Dermot Boyle, G.C.B., K.C.V.O., K.B.E., A.F.C., who is now to undertake "special responsibility" for co-ordinating the administration of personnel and training and education within the group. This appointment, the announcement says, has been made in view of the importance the board attaches to "establishing a sound, progressive and integrated policy in this field." Sir Dermot joined the B.A.C. board in March of this year.

Succeeding Sir George Edwards as managing director of Vickers-Armstrongs (Aircraft) will be Mr. A. W. E. Houghton, A.F.R.Ae.S., who has been assistant managing director of the company since May of this year. He has been with Vickers-Armstrongs since 1922 and had been general manager since 1957.

Firmer Fokker/Breguet Ties

EXISTING ties between the French Breguet and Dutch Fokker companies, already in existence for the construction of the Atlantic NATO anti-submarine aircraft and other projects, have been strengthened by the recent announcement of an important agreement to transfer much of the Friendship production to France. Under this agreement, Breguet will begin —in four or five months' time—production and sub-assembly of the Friendship fuselage, except for the cockpit section, together with the flaps, ailerons and parts of the tail.

After construction at Biarritz, these components will be transported by road to Schiphol, for final assembly. About 70 Breguet technicians are currently studying Friendship production at the Dutch factory for familiarization, and the French company will continue its participation throughout the remainder of the manufacturing programme.

Fokker is engaged in the large-scale NATO production programme for the F-104G. The new arrangement will facilitate completion of the orders which have been received in increasing numbers for the F.27 Friendship.

Following these announcements, the Fokker company gave some details of the initial result of its recruitment of skilled labour from Northern Ireland and the U.K. to help meet its expanding commitments and present backlog of orders. The first party of craftsmen—13-strong from Belfast—started work at Schiphol last week. They are on a one-year contract and, according to the company, all had been unemployed because of redundancies in the aircraft and shipbuilding industries in Northern Ireland. Fokker's recruiting drive continues.

A Blow to Bristol Siddeley

BRISTOL SIDDELEY ENGINES confirmed early this week that the Indian Government has decided not to use the Orpheus BOr.12 engine in production versions of the HF24 supersonic fighter. A Russian engine, the VK7, is to be used instead. The prototype HF24 is powered by two 4,850 lb.s.t. Orpheus 703s, but the full performance potential of this Kurt Tank-designed aircraft requires additional power and this could have been provided by the BOr.12, which has a dry rating of 6,810 lb. and gives 8,170 lb. with Bristol Simplified Re-heat. It has been developed to the flight-test stage (in a Sabre) by Bristol Siddeley as a private venture, but is not at present being actively worked on.

In negotiating with the Indian Government, Bristol Siddeley had suggested that a joint development and production programme might be supported by India and Egypt, since the BOr.12 was also a prospective powerplant for the Hispano Ha 300, a delta-wing fighter designed by Messerschmitt in Spain and planned for production in Egypt.

The Russian VK7 is attributed to V. Y. Klimov, one of the earliest designers of jet engines in Russia, and is said to be similar to the Orpheus in general characteristics, with a thrust of 6,700 lb. As it is already in service in Russia, its cost to India is likely to be lower than that of the Orpheus, political considerations apart, and this factor has probably outweighed such disadvantages as higher weight and fuel consumption. Production of the 4,700-lb.s.t. Orpheus 701 for the Folland Gnat by Hindustan Aircraft at Bangalore is not affected by the decision.

Soviet Long Shot

FIRST in the series of new and more powerful multi-stage carrier rockets was launched from the U.S.S.R. (probably Baykonur) into the central Pacific on Sept. 13. *Tass* stated that the dummy final stage covered more than 7,500 miles and hit the water less than one kilometre from the target centre.

The flight of the rocket and the operation of all its stages fully conformed with the set programme, the announcement added. The last stage but one burned out as planned while re-entering the dense layers of the atmosphere. A second rocket, launched on Sept. 18, was stated to have deposited its dummy final stage in almost the same spot as the first.

Earlier long-range firings into the Pacific were made by the Russians in January and July last year as a prelude to the launching of Vostok-type spacecraft and the Soviet Venus probe. It may be that the latest tests signify the addition of another stage to the basic booster, providing for the orbiting of heavier payloads or the projection of Vostok-size payloads to escape velocity. Possible applications for the improved launcher were reviewed in our issue last week.

REMEMBERING THE FEW.—The Prime Minister Mr. Harold Macmillan, with Marshal of the Royal Air Force Lord Newall, and the Secretary of State for Air Mr. Julian Amery, attended the Battle of Britain commemoration parade past the Trenchard Memorial, on Sept. 17. Lord Newall, who was C.A.S. in 1940, took the salute.

Photograph copyright "The Aeroplane and Astronautics"

Hawker P.1127—the Next Phase

NOW that the Hawker P.1127, with its Bristol Siddeley BS.53 powerplant, has demonstrated its ability to fly under complete control from hovering to its very high forward speed, it is understandable that, at long last, things have begun to move in this new field where the opportunities lying open to this country could be so rewarding.

As is customary, news about further developments in British designs has come from the Continent. As we report elsewhere (p. 391) it has been stated in France that the successor to the P.1127 is the P.1150 which is said to have supersonic capability and to be powered with a developed version of the BS.53 having a thrust of 17,500 lb.

No thrusts have been officially attributed to the Pegasus (BS.53) in its present form but clearly it will be considerably less than the 17,500 lb. quoted for its developed version by this French source. In fact it is understood that one of the reasons for the jubilation among the Hawker team is due to the success of the demonstrations achieved with a lower power than that promised for the existing engine. The engine has certainly come a long way since its original concept with 8,000 lb. of thrust for lift purposes from the bypass fan only.

A notable feature is the introduction of contra-rotation between the fan and compressor with all the advantages that this confers when it comes to control and manœuvrability.

An early model of the engine first flew less than a year ago, when, on Oct. 21, 1960, the P.1127 made its first hovering flight. The next notable stage was when the P.1127 flew as a normal aeroplane with the jets horizontal on Mar. 13 last. Thus to have made a number of transitional flights by the end of this week is an achievement of which the joint Hawker/Bristol Siddeley team can properly be proud.

There will be universal regret that the programme could not have been completed just that much earlier so that the pilots concerned, Bill Bedford and H. G. H. Merewether, could have demonstrated their prowess at the Show at Farnborough.

The future of the P.1127 will be followed with close interest now the Government policy with regard to the design is clarifying itself. In the past the long line of Hawker successes in the fighter field to the designs of Sir Sydney Camm have led to great successes in the export market.

Once again the design talent which has always married light weight to high performance has produced a machine in which the whole capability depends on strenuous weight control. What is the future going to be?

Whatever does happen, the sooner the R.A.F. get some VTOL aircraft to fly the better. Until the operational commands are able to make practical experiments with such a radical change in military aircraft design, everyone will be working, as it were, with one hand behind their backs.

International Tragedy

LAST Monday's news of the death in an air crash of Mr. Dag Hammarskjoeld, Secretary-General of the United Nations, was an extreme shock not only in the world of international affairs but in the very much smaller world of air transport.

The almost continuous use of air travel by politicians, and other people who are forced, by the nature of their duties, to move as quickly as possible from place to place, has long been normal. The small risk is accepted but that taken by Mr. Hammarskjoeld has often been the greater because he has travelled in areas where aids are sparse and conditions primitive.

His aircraft, a Transair, S.A. (Sweden) DC-6B, was reported missing on a flight from Leopoldville to Ndola, Northern Rhodesia. The wreckage was discovered about 7½ miles from its destination.

Encouraging the R.Ae.S. I.A.S. C.A.I. Conference

THREE gracious messages of good will were received by the Royal Aeronautical Society at the opening of the Anglo-American conference last week.

From Her Majesty The Queen, as Patron of the R.Ae.S., came the following telegram to its president, Air Marshal Sir Owen Jones:—

> *"Please convey to the Council and members of the Royal Aeronautical Society the sincere thanks of the Queen for their kind message of loyal greetings which Her Majesty as Patron of the Society deeply values. The Queen hopes that the Eighth Anglo-American Conference will be in every way successful and sends her warm good wishes to all attending it."*

President Kennedy sent the following message from the White House to Dr. H. Guyford Stever, president of the Institute of the Aerospace Sciences:—

> *"On the occasion of the Eighth Anglo-American Aeronautical Conference, will you convey to the delegates of the Royal Aeronautical Society, the Canadian Aeronautical Institute, as well as those of our own Institute of Aerospace Sciences, my greetings and wishes for a successful meeting. The field of aerospace engineering and science has provided us with many spectacular advances during recent years and we are looking forward to even greater strides in the near future. I hope that these exchanges between the societies of the British Commonwealth and the United States will be mutually advantageous and that they will serve to strengthen the ties that already bind our nations together."*

His Royal Highness, The Prince Philip, Duke of Edinburgh, as Patron of the Canadian Aeronautical Institute, sent the following message from Buckingham Palace:—

> *"We are living in a period of very rapid progress in the aeronautical and space sciences. Frequent discussion between people engaged in this work is essential if full advantage is to be taken of the widespread research effort. I am sure that this Conference will give rise to much new thinking.*
>
> *"To all the delegates of the Eighth Anglo-American Aeronautical Conference I send my best wishes for a successful, enjoyable and, above all, fruitful occasion."*

MEN IN THE NEWS.—Left to right, Air Marshal Sir R. Owen Jones, president of the R.Ae.S. presents Sir Sydney Camm with the Society's Honorary Fellowship; Dr. S. G. Hooker receives the British Gold Medal for Aeronautics; and Mr. Raoul Hafner, the R.Ae.S. Silver Medal. At bottom right, Air Cdre. W. P. Gouin, president of the Canadian Aeronautical Institute, talks with its secretary, Mr. H. C. Luttman.

Support for the German Industry

ATTEMPTS are being made by the West German government to provide a measure of support for the development of civil aircraft of original German design. Hitherto, the West German industry has had to finance such development privately, unless military contracts were available. Only a few months ago, Hamburger Flugzeugbau abandoned development of its HFB-314 rear-engined short-haul project because Government backing was not forthcoming.

As a first step towards finding a formula which will allow the Government to take some interest in promising projects, a meeting was held on Sept. 13 by representatives of the Ministry of Defence, the Ministry of Economics and the Ministry of Transport. The technical details of six current prospects were reviewed. These were an executive rear-engined twin-jet by Hamburger Flugzeugbau; the Dornier Do 28 light transport and the three-engined Dornier P.346, a 10-12 seat development of the Do 28; the SIAT 223 basic trainer; the Potez Heinkel CM-191 four-seat executive jet; and the Heinkel He 211, a short-haul transport project which has been proposed in both turboprop and turbofan versions.

Russia's Space Programme

A LECTURE which should prove of outstanding interest to the space fraternity is being given tomorrow evening (Sept. 22) by the former Soviet rocket specialist, Dr. G. A. Tokaty. He has been invited by the British Interplanetary Society to speak on "Soviet Space Technology."

As chief rocket scientist of the Soviet government in Germany in 1945-47, Dr. Tokaty has a wide and intimate knowledge of his subject. He is now Head of the Department of Aeronautics and Space Technology of the Northampton College of Advanced Technology in London. The meeting will be held in the R.Ae.S. Lecture Theatre (4 Hamilton Place, London, W.1) at 18.30 hrs.

Airborne Fifty

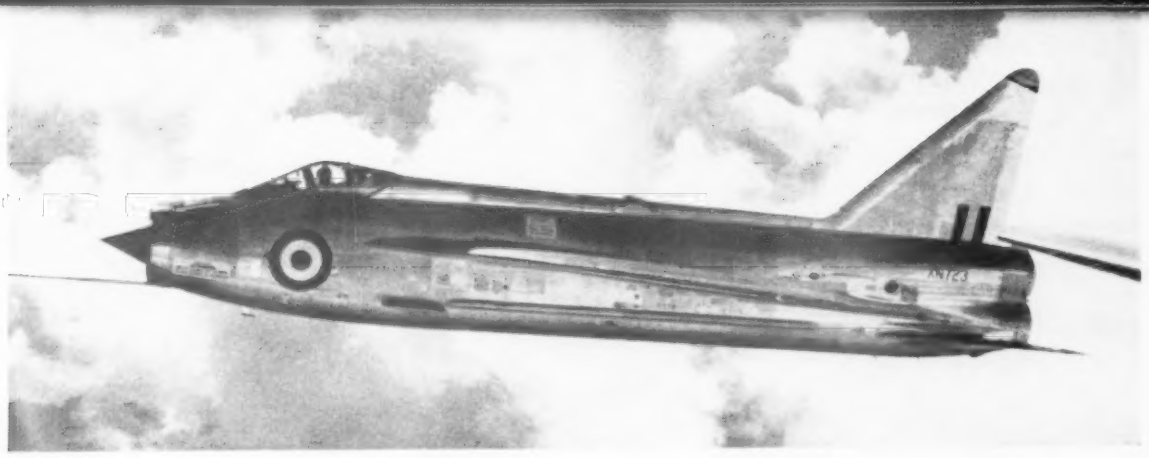
ANYBODY watching Henry Petre briskly mounting the steps of 119 Piccadilly one evening last week would not have been particularly surprised to learn that the small, quiet man was a solicitor, retired these past two years. They would probably wish, if they were, say, my age, that they might be as active as he is at his age, which is 77, especially when they knew that he was a practising aviator and ice skater and had been so since 1911.

Inside 119, members of the Royal Aero Club were assembled to dine Major Henry A. Petre, D.S.O., M.C., in celebration of his fifty years of piloting. Ten years before, the Club had awarded him its Silver Medal to mark a lifetime devotion to aviation, kindled in his youthful breast by pioneers like Maxim.

He started work as an aeronautical engineer in 1909 and qualified for R.Ae.C. Pilot's Certificate No. 128 in 1911. In 1913, the Australian Government wanted to start their own air force and advertised for someone to take on the job at £400 p.a., quite good money in those days. Henry Petre was then an instructor at Brooklands on, among other types, the Deperdussin monoplane. Privately, he didn't think much of it but because the Australians wanted it, and him, he took Eric Harrison, two Deps., two B.E.A.2As and a Bristol Boxkite to Point Cook, near Melbourne, and founded the Australian Flying Corps and Central Flying School, just like that.

Then he fought and flew with the A.F.C. in Iraq and later with the R.F.C. and R.A.F. in the Middle East and U.K. He finished his professional flying in 1919, on demobilization, but turned to private flying and gliding, later setting up British gliding endurance and height records. Came the Second World War and the Government took away his lovely Puss Moth AAVB, so he became an honorary gliding instructor to the A.T.C. Since the War he has been, he says, "just a happy private flyer."

On his 50th flying anniversary, he flew an Elstree F.C. Auster over the Radlett airfield of Handley Page, with whose illustrious chairman he worked in 1912. Sir Frederick was at the R.Ae.C. dinner, as was Air Vice-Marshal A. M. Murdoch, A.O.C., R.A.A.F. in the U.K. Henry Petre's record is surpassed only by that of Cecil Pashley, in this country anyway, and probably anywhere else.—WREN.



LATER LIGHTNING.—First photograph to be released of the Lightning F.2 which is to follow the F.1 into service with the R.A.F.

Aviation News in General

STILL THE HEAVIEST.—According to present plans the five Vickers VC10s for R.A.F. Transport Command will be of the 299,000-lb. variety, rather than the developed type at 310,000 lb. They will still be, as we remarked last week, the R.A.F.'s heaviest aircraft.

HAWKER PROJECT.—Our French contemporary *Les Ailes* records P.1150 as the design number of a Hawker project developed from the P.1127 with supersonic performance using a version of the BS.53 Pegasus engine rated at more than 17,500 lb. thrust. Mention is also made of the BS.100 engine project of 36,000 lb thrust.

AUTOPILOT SALE.—A repeat order, worth £190,000, has been received by Smiths Aviation Division for SEP. 2 autopilots and flight instruments for the Luftwaffe. This equipment was originally supplied in 1958 for all the Luftwaffe's licence-built Noratlas transports. One of these aircraft is now being prepared for trials in Germany of the R.A.E.-developed Autoland system which uses the SEP. 4 autopilot and Smiths' Type 4B flight system.

TRAINER ORDER.—The Canadian Government has announced that it is to purchase the Canadair CL-41 *ab initio* trainer for the R.C.A.F. No procurement figure has yet been given but it is expected to be about 200.

CANADAIR YUKON.—The R.C.A.F. has given the name Yukon to its twelve Canadair CL-44Ds, now in service with Air Transport Command. Two of the Yukons have been designed with specially equipped convertible interiors for V.I.P. use when required, and will replace the Canadair C5 which has been the R.C.A.F.'s V.I.P. transport since July, 1950.

DOVE DELIVERIES.—Latest purchasers of the D.H. Dove are the Royal Malayan Air Force, who took delivery of two Dove 7s and a Dove 8 on Sept. 6 and the United Arab Republic who received a Dove 7 the following day.

MAGISTER SORTIES.—An active part in the recent Katangan operations against United Nations forces has been taken by one of the Fouga Magister jet trainers of the K.A.F. Reportedly flown by a Rhodesian pilot, from the airfield of Kolwezi, the Magister has bombed and strafed civil aircraft at Kamina and Elisabethville, and is claimed by Katanga sources to have shot down a DC-4 in U.N. service. Another DC-4 was certainly destroyed on the ground at Elisabethville during the ground strafing. Three F-86F Sabres of the Ethiopean Air Force are unofficially reported to have been sent to the Congo to provide air cover for the U.N. forces.

COCHRAN AGAIN.—A second World's speed record in the class for women has been beaten by 55-year-old Jacqueline Cochran. At Edwards A.F.B. on Aug. 31 she averaged 659.6 m.p.h. over a 500-km. course, again in a T-38 Talon, to beat her previous best over this distance, established as a record in 1953 when flying a Canadair-built F-86E Sabre, by approximately 130 m.p.h.

HUGHES SUCCESS.—Hughes Tool Co.'s Model 369, originally rejected in the U.S. Army competition for a light observation helicopter, has now been selected for prototype evaluation in addition to the Bell HO-4 and Hiller HO-5. Each company will build five prototypes Hughes' type is designated HO-6.

GREEK STRIKER.—First Fiat G-91R/4 for the Royal Hellenic Air Force was handed over at Turin on Sept. 6.

X-15 AGAIN.—A North American X-15 piloted by J. Walker reached 3,645 m.p.h. (subject to revision) on Aug. 12. This is 42 m.p.h. faster than the previous best attained in June. Walker throttled the engine to 50% shortly after launch when a fuel pressure drop was indicated. The X-15 had modifications to the wing skin to reduce heating from boundary layer friction.

METEOR TUGS.—Whitworth Gloster Aircraft Co. has a contract to convert 15 Meteor N.F.11s to TT.Mk.20 target tugs. They will be used by the R.N. at Malta, for exercises with the Mediterranean Fleet and shore-based Naval squadrons.

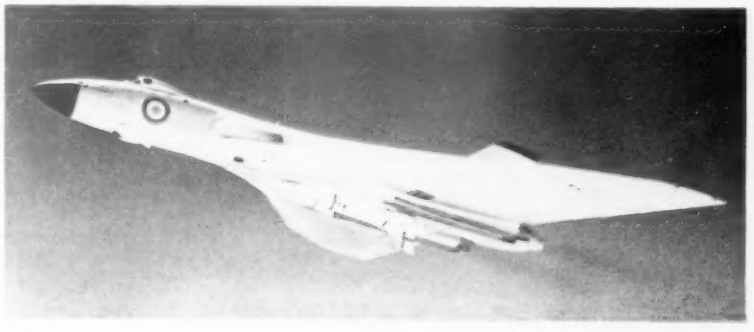
AIR FORCE CONSTELLATIONS.—The Indian Air Force is to take over the nine Air India International Super Constellations as they become surplus to the airline's needs, according to reports in India.

ROCKETEER SKIS.—A contract to supply new main landing gear skis for the North American X-15 research aircraft has been announced by Goodyear. Designed on the "wire brush" principle, they will make possible landings on standard asphalt and concrete runways. Existing smooth skis were designed for touch-downs on the dry lake bed at Edwards A.F.B. Similar "wire-brush" skis will be used on Dyna-Soar.

MORE DISCOVERERS.—A re-entry capsule from the satellite Discoverer XXX was successfully air-snatched by a C-119 recovery aircraft as it parachuted down near Hawaii on Sept. 14. Launched two days earlier from Vandenberg A.F.B., it had orbited the Earth 33 times. Discoverer XXXI was successfully placed in a similar polar orbit on Sept. 17.

VOSTOK MOD.—According to *Pravda*, the Soviet spacecraft Vostok II had a modified air regenerating unit differing from that of Vostok I "as regards its arrangement, chemicals and design."

(*More news on page 411*)



BLUE STEEL BOMBER.—First picture also to show the Blue Steel stand-off bomb under a Vulcan B.2.

Air Transport

U.S. Objectives in the Next Decade

SWEEPING recommendations are made in the report to President Kennedy of the task force which he set up last March to study national aviation goals. The study, aptly named Project Horizon, has been made under the chairmanship of Mr. Fred M. Glass; the eight-man task force has studied the whole of the aviation field, excluding only those matters relating to combat operating forces. Its task was to define national aviation goals from now until 1970, which would provide a basis for practical long-range planning.

The 87,000-word report has been accepted by the President, who has now instructed the Federal Aviation Administrator, Mr. Najeeb E. Halaby, to "take the lead in developing recommendations for specific actions which can be taken by this Administration to achieve such a national aviation programme."

The 24 goals listed in the report (see below) represent a working blueprint for the Administration, the aircraft manufacturers, the airlines, Government agencies and general aviation. In addition, the report contains a discussion of the various areas of aviation considered, with a number of specific recommendations under each heading, and a detailed presentation of the material on which the recommendations are based. The more important recommendations are summarized here; we hope to return next week to a consideration of some of the projections made in the report.

Air Vehicles

The U.S.A. must, says the report, maintain its position as the World's leading developer and builder of all major categories of aircraft. This will require an accelerated effort across the broad spectrum of aviation. In some cases the Federal Government will have to participate financially to an extent never before experienced; in other cases, privately financed endeavour is called for.

In the subsonic transport field, efforts should be made to improve economy, reliability and performance. It will be technically feasible to produce safe, efficient and economical subsonic transports of two new types in addition to those already under development. These are: a twin-turbofan, 60/90-seat transport with a design range of 1,200 st. miles cruising at 450 m.p.h., and a four-turbofan, 250-seat transport with a design range of 850 st. miles cruising at 450 m.p.h.

The U.S.A. should begin immediately an intensive applied research programme to establish the preferred design parameters for a Mach 3 transport. A detailed operating requirement should then be drawn up for a design competition, with a prime contractor selected by early or mid-1964 for design, development, test and production.

There will be a requirement for a new all-cargo turbine transport with a 30,000-lb. payload for the short/medium-haul market.

Airports and Air Terminals

Plans should be made for a minimum of five major new airports and 150 suitable for general aviation. A complex of airstrips is required to provide "national air accessibility."

All airports with a substantial volume of traffic, and which are properly located, should have ILS, runway lighting and air traffic control.

International

Continued U.S. pre-eminence in international air transport is unquestionably in the national interest, says the report. The decline of U.S. flag carrier participation in the World air travel market requires concentrated attention.

Aviation policies, as they affect the U.S. flag carriers, must be given greater recognition at the highest levels of Government. A comprehensive study of international aviation relations, commissioned by the President, is considered to be mandatory.

Among the immediate actions which are necessary and possible without legislation, the following points are mentioned: correcting route inequalities where foreign carriers enjoy more favourable routes than U.S. flag airlines; remedying instances in which foreign carriers compete with U.S. carriers at fares lower than those permitted by the C.A.B.; providing aggressive support by the U.S. Government for U.S. airlines, equal to the support supplied by foreign countries to obtain and protect transport rights for their own airlines; examining and correcting unreasonable restrictions imposed by some foreign governments on U.S. airlines.

Exports

Aviation exports are significant in relation to the American balance of payments position. Diplomatic and technical missions abroad, says the report, must help to support the sales efforts of U.S. manufacturers and U.S. airlines. Foreign governments should be encouraged to re-examine open or hidden trade restrictions which restrict U.S. aviation sales abroad.

Airline Finances

Consolidated cash requirements for the 13 major U.S. airlines for the period 1961-65 are estimated to total some $2,543 million (including $1,900m. for equipment purchases). Depreciation, amortization, available credits and sale of surplus aircraft are expected to realize $2,332 million, leaving a balance of $211 million required; of this, $109 million is needed by the six

U.S. National Aviation Goals—1961-1970

1. Establish a comprehensive and viable programme for the development of a National Aviation System which will make maximum contributions to: national economic growth; national security; national culture; international commerce and trade; World peace.

2. Maintain World leadership in all phases of aviation.

3. Expand the appropriate utilization of aviation as an integral and indispensable part of the total national transportation system.

4. Maintain a financially sound, technologically alert, privately owned aviation manufacturing industry.

5. Attain and maintain an economically healthy, competitive, privately owned air-carrier system capable of meeting the growing national needs of peacetime domestic and international air commerce, while being immediately available for military use in emergency.

6. Accelerate the growth of general aviation, enhancing both the business life and leisure time of those who use it.

7. Support and encourage accelerated development of the civil air cargo industry.

8. Develop and implement a single system for air traffic management which will ensure the safe and efficient utilization of airspace by all users—civil and military.

9. Achieve efficient and unified operation of such an air traffic system by establishing, within the F.A.A., a Federal Aviation Service which would operate the system in peacetime on a civilian basis, but which would become an integral part of the military services in time of national emergency or war.

10. Plan and implement a long-range, nation-wide system of airport and terminal development capable of keeping pace with the projected growth of air traffic.

11. Support an accelerated, co-ordinated, integrated aeronautical research and development programme directed to advancing the state of the aviation art in a manner that is responsive to the needs of civil, as well as military, aviation.

12. Encourage and support the U.S. flag air carriers in their efforts to expand and to compete profitably and equitably in the international market.

13. Recognize and exploit the manifold contributions which aviation can make to foreign policy objectives, particularly in and with the emerging countries.

14. Develop an economically efficient Mach 3 transport aircraft for service on domestic and international routes beginning in the early 1970s.

15. Explore and exploit fully the development of economic short-haul vehicles with vertical and/or short take-off and landing characteristics.

16. Ensure maximum joint use by both military and civil aviation of Government-financed aviation facilities and installations.

17. Reduce the frequency and consequences of aviation accidents through systematic attention to principal causes and objectively derived corrective measures.

18. Reduce bad-weather delays and dangers by co-ordinated programmes of research and implementation directed to improved methods of forecasting weather, of distributing weather information and of operating in bad weather.

19. Recoup from each air user, in an equitable and just manner, his fair share of the Government's investment in the National Aviation System.

20. Gradually reduce and ultimately eliminate Government subsidy to the air transport industry, except where uneconomic operations not attributable to inefficient management are required in the public interest.

21. Integrate aviation more fully into community life by reducing the degree of risk, inconvenience, discomfort and possible injury to person, or damage from air operations in or over populated areas.

22. Encourage a greater use of the air by using regulatory powers in seeking lower passenger fares and cargo rates, consistent with an adequate profit margin for efficiently conducted operations.

23. Pursue legislative and regulatory philosophies and processes which maintain a fair and equitable balance between legitimate private interest and the public welfare.

24. Encourage a broader understanding of the challenges and promises of aviation through education and information programmes.

smaller trunklines which in 1960 had a net loss of approximately $9 million. Earnings are the key to the airlines' financial stability. Over the past four years, the rate of return of this 13-airline group was 5.3%. If the 1960 pattern of earnings prevails throughout the decade, the industry will be in serious trouble.

The C.A.B. can help the airlines to return to profitable operations by giving prompt and sympathetic consideration to merger proposals, refusing to certificate new inter-carrier competition unless clearly justified, and giving sympathetic consideration to tariffs designed to stimulate and promote new sources of traffic.

Local airlines, which now have to buy new equipment, should be urged to obtain additional equity funds as soon as possible. A similar comment is made of the helicopter operators.

Regulatory

There is need for a basic reorientation of the present regulatory approach. Controls should be eliminated to the maximum extent consistent with the public interest, so that business incentives and competition may play a more influential rôle in the regulation of rates and services. The C.A.B. should permit wide latitude to the carriers in pricing their services. Mergers which result in strengthening marginal carriers, eliminating uneconomic competition and providing new and or improved service to the public, should be encouraged.

Expanding Market

The non-business or pleasure market provides the greatest opportunity for broadening the base of air transportation. An airbus, suitably designed to operate at lower costs and as a replacement for existing capacity, could produce a greater reduction in fares, particularly in a short/medium-haul market, than existing equipment utilized in high-density layouts, and would cause less diversion from existing higher-fare business.

The long-range prospects for air freight remain promising. The markets to be sought are medium and long hauls where scarcity, perishability, unpredictability of demand, or high value require quick response and speed of shipment. Government support of air cargo aircraft development is called for, together with expanded use of air cargo services for mail and military cargo, and guaranteed loan legislation.

In dealing with tariff filings, the C.A.B. might concern itself less with legal niceties and focus more on the creative effects of a proposed tariff in terms of penetrating and developing new markets.

Economics of A.T.C.

Costs of the air traffic system should not be wholly charged to the users, but a more equitable method of assessing costs against actual users should be sought. Consideration should be given to repealing the 10% transportation tax on common-carrier passenger travel.

Research and Development

More centralized co-ordination of civil aviation research and development is recommended by the report, which suggests the formation within NASA of a senior technical group charged with providing broad leadership, direction, guidance and co-ordination to the entire aviation community in aeronautical R. and D.

OPtional Reading—12

IN dealing in this column with the operational aspects of commercial flying, I find myself with five main themes in mind: air traffic control, landing hazards, long- and short-range navigational aids, vertical separation and air/ground communications. I expect to return frequently to these main themes as and when occasion offers, but meantime little passages of "continuo" are needed—not necessarily of epic dimensions, but nevertheless of some importance. I propose to clear them off one or two at a time, the one this week being the falling-off of meteorological reports from high-flying aircraft—i.e., the transmission of the MET section of the AIREP.

Now in this, as in all matters, I would prefer the position of a mentor rather than a tormentor of the airlines, but the fact of the matter is that this is not a case of an ICAO regulation being out of date; the ink is hardly dry on the modified proposals for the air/ground transmission of MET information and yet we hear of some airlines instructing their jet crews not to transmit this data. In some cases the crews are asked to hand it in at the end of the flight but in others no specific instruction appears to be given and quite often the MET man receives nothing.

Until recently there was a general ICAO requirement for the regular transmission of meteorological information (temperature, wind, D-value, etc.) from all aircraft engaged on long-haul routes, the exact arrangements being determined regionally. However, with the greater volume of traffic, the greater congestion on the air/ground communication channels and the greater pressure of work in the cockpit, an understandable move had developed to suspend or to reduce this requirement. In the case of aircraft flying below 25,000 ft. (i.e., the non-jet) there was indeed a good case for this in many regions of the World and this was recognized early this year by the Council of ICAO when it approved a new requirement exempting such aircraft from these duties, save over a few specified routes as determined at Regional meetings.

At no time, however, was the exemption intended to apply to jet aircraft. There were several good reasons for this. In the first place, it is in the upper levels where MET information derived from ground sources is most deficient, simply because fewer stations have the technical equipment to make high-level observations. Also the ground MET observer becomes noticeably less efficient when dealing with the upper air; sometimes his equipment (balloon or radar) fails him at the higher altitudes and sometimes (especially in the East) his training is not equal to the task of following the balloon to the extreme levels. Secondly, it is in the upper levels where some of the routine information, especially that on temperature and winds, is more critical to the safety of operations. Thirdly, the number of civil aircraft operating in the upper regions cannot be said to be so great that there is a superfluity of reports (as had been argued in the case of operations below 25,000 ft.).

Practices in this matter vary from airline to airline and from Region to Region. Over the North Atlantic the supply of upper-level in-flight MET reports is fairly good; over Burma it is poor. The reasons for these variations are not always clear but perhaps one is that over the North Atlantic one crew member is assigned mainly to navigational duties and he therefore has time to record and send the weather information. This time factor is, of course, of very great importance in the jet and, if crew complements are small, there may be just not enough hands to perform this function. Crew complements tend to be small on the Middle and Far East runs and hence, perhaps, a reason for the falling-off there of in-flight MET reports. Another reason for the differences may well be that, over the North Atlantic, crews believe that their data is put to quick and intelligent use; they see this at their own pre-flight briefings. Over many parts of the Middle and Far East, however, this is manifestly not the case and the feeling develops that it is not worth while to load the ether up with stuff which is either ignored on the ground, or for which the facilities for ground-to-ground exchange do not exist.

All the same, it seems wrong for the airlines not to give of their maximum in this respect. It would be difficult to measure, in economic terms, the loss to the industry arising from an inadequately supplied MET-forecasting service, but clearly indirect operational penalties are incurred whenever, for lack of basic data, the expression "confidence low" appears on the forecast. The direct results of this will often be extra fuel uplift, more diversions or cancellations—some of them really unnecessary if the weather could have been forecast with a better degree of certainty.

The above are immediate reasons for maintaining the flow; however, there are two further reasons which will come into play in the future, namely "numerical forecasting" and supersonic flight. I do not suppose that, at the present time, many MET men visualize the entire prediction of atmospheric movements and metamorphoses by means of computers; but certainly the computer will enter more and more into the field of forecasting and, to feed the beast, an abundant supply of raw fodder will be required. Similarly, the supersonic aircraft, if it is to be operated economically at all, will depend on very accurate MET data (especially in relation to wind and temperature) from the upper levels. This data cannot be adequately supplied from the ground and it is unrealistic to expect that governments are going to provide an observation network density much greater than that provided now.

But not only can in-flight air reports add greatly to the basic data: in at least two important respects they can supply more accurate data. With the fitting of Doppler, now fairly general on the jet, excellent spot or mean winds can be derived; and, with the greater knowledge of compressibility and other sources of error, airborne temperature readings have become more reliable.

So let us retain the full AIREP at least in the upper levels and, if the reasons for the falling-off are workload and communications, then these are the areas to which operators and governments should direct attention.—C.C.J.

CITY OF DARWIN.—A pleasing study of a Qantas Boeing 707-138B, one of the four new turbofan-powered transports of this type now being delivered to the Australian operator.

Air Transport . . . .

The Tangled Skein at Heathrow

BRITISH and foreign airlines using Heathrow were due this week to discuss the proposed new passenger-handling arrangements with the Ministry of Aviation. The Ministry has proposed, as a means of reducing congestion in the central area building, the institution of a three-way division of incoming flights between the Heathrow passenger terminals.

B.O.A.C. (see last week's issue, p. 350) is, with its partner and associate airlines, to move into the new long-haul terminal on Nov. 13. But only departing passengers will be handled there; arriving passengers will pass through the international section of the short-haul terminal (No. 1 Passenger Building). The Corporation has been warned that some of its flights may need to be handled at the old north side terminal during peak periods. This situation has been accepted by B.O.A.C. on the condition that other airlines suffer an equivalent inconvenience.

Present users of the central area passenger building are afraid that their flights may be switched to the north terminal at short notice, that their turn rounds will consequently be delayed and that there will be a disruption of their passenger-handling arrangements.

Constellation Question

BECAUSE sections of the tail assembly of the T.W.A. Constellation, which crashed at Chicago on Sept. 1, were found nearly 300 yards from the main impact area, the F.A.A. has asked T.W.A. and several supplemental carriers to inspect their L-049s for signs of metal fatigue in the tail area.

This inspection is "purely precautionary" and the overall investigation of the accident is still at an early stage. The main debris was concentrated in a relatively small area—suggesting a steep final dive angle—and one of the larger portions of the separate tail-assembly wreckage consisted of the starboard fin, rudder and trim tabs.

The Constellation (see our issue of Sept. 7, p. 297) crashed three minutes after take-off from Chicago's Midway Airport. Reports that an amateur radio operator had heard the pilot speaking to the tower about an electrical fire have been rejected: tape recordings from the tower show that the last message from the aircraft was a simple acknowledgment of clearance.

Runway Distance-to-go Markers

VARIOUS methods have been suggested and tried for providing runway distance-to-go information to the pilot on take-off and landing. The usual method has consisted of boards at the side of the runway, but these have proved themselves to be difficult to use in poor visibility—when distance information was most needed.

The Ministry of Aviation has been making trials of a system using large numbers painted on the runway in such a shape and size that they can be fairly easily read when seen ahead from control cabin height and are foreshortened. The results of the trials have justified the application of the system, this autumn, to important U.K. runways which are critical for landings.

According to *Information Circular No 76*, these figures will be approximately 100 ft. by 5 ft. in overall dimensions, with a black surround when on concrete, and will be some 10 ft. to the left of the runway centreline in each direction concerned. The single figures will indicate the number of thousands of feet to go to the far end of the runway. The first figure will not be closer than 2,000 ft. from the landing threshold; the last, the figure "2," will be 2,000 ft. from the upwind end of the runway.

The Rabat Accident

THE Air France Caravelle (F-BJTB) which crashed near Rabat on the evening of Sept. 12 was flying on the Paris-Casablanca service and was making an approach to Sale Airport, Rabat, or was holding temporarily at low level.

According to reports, the local visibility was poor but variable, with banks of fog, and the Caravelle crashed, undercarriage down, about seven miles south-west of the airport, ploughing about 300 yd. along a hillside before falling into a ravine and burning.

The normal approach for Sale Airport involves flying on a heading of 197° before turning and homing on the NDB on a heading of 008°. The airport elevation is 276 ft. a.s.l. and the ground rises in the S.-S.W. sector.

Among the 71 passengers and six crew, all of whom lost their lives, was the Australian Ambassador to the United Arab Republic, Mr. J. P. Quinn, and the commercial counsellor at the French Embassy in Morocco, M. Pierre Laurent.

The accident brought to 238 the number of people killed in major air crashes during a period of 12 days. The 1961 safety record was fairly good during the first six months, but later accidents have brought the total of passenger deaths to 667 in 18 crashes involving aircraft on scheduled services between Jan. 1 and Sept. 13, 1961. The figures for the comparable period of 1960 were 567 passenger deaths in 26 accidents; the total for the whole of the year was, according to ICAO, 857 passenger deaths.

Flying to Madeira

UNDER the terms of its agreement with the Portuguese operator T.A.P., B.E.A. is to operate Comet 4Bs to Porto Santo, in the Madeiras, from Dec. 6 (see our issue for Aug. 31). They will carry T.A.P. insignia and will be on charter to T.A.P., which will provide cabin crews for the Lisbon-Porto Santo sector of the service. Three of the six London-Lisbon Comet services a week at present are also flown on behalf of T.A.P.

The strip at Porto Santo has been in operation since the end of last year and is at present served only by T.A.P., using its own Super Constellations or piston-engined aircraft chartered from other operators.

A correspondent who recently flew to Porto Santo with T.A.P. has provided the following account of the service, including the first eye-witness description of both the airstrip there and that under construction on the "mainland" near Funchal.

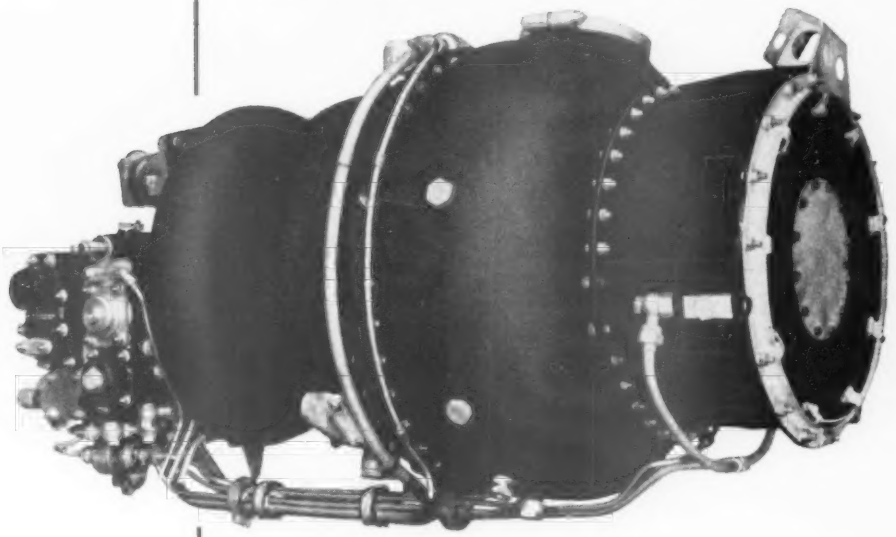
"We flew out of London in T.A.P. L-1049G CS-TLC at 05.20 on Aug. 30, reaching Lisbon (Portela) some four hours later. After a wait of a little under three hours we were off again in DC-6B F-BGSN, a U.A.T. machine leased to, and in the livery of, T.A.P. The aircraft was less than half full, but in contrast, on our return the following week the flight was actually overbooked.

"The trip to Porto Santo took roughly 2½ hours and we finally let down through some low broken cloud to make a landing on runway 01. Porto Santo has a single runway (01/19) of approx. 6,600 ft. and is located on a narrow neck of land on a plateau above the little port from which the island takes its name. Approaches to the runway from both directions are unobstructed, but there is considerable high ground to east and west which constitutes a major hazard. There is no runway lighting at present, but runway cone markers are provided.

"A pleasant little restaurant and bar are available, and T.A.P. operate a coach for the transfer of passengers to the little quay, thence to the ferry connection with Funchal. The ferry connection is the only real drawback, as this is a converted tug with a flat bottom, and definitely not intended for ocean-going. The journey from Porto Santo to Funchal takes at least four hours, and on the return the wind made

(*Continued on page 395*)

A new contribution to the small gas-turbine field



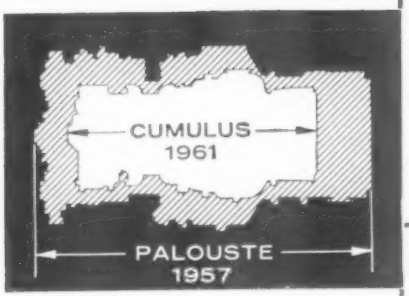
Specialists in the development and production of low-pressure-air starters and airborne auxiliary power plants Blackburn keep pace with modern aircraft design trends.

To meet the aircraft designers' requirements, for superior performance with reductions in weight and overall dimensions,

Blackburn (LICENSEES FOR TURBOMECA ENGINES) **introduce**

their latest development

the CUMULUS



Weight	Length	Max. diameter	Rating	Air Delivery (lb./sec.)	Pressure (p.s.i.a.)
210 lb.	34 in.	19·5	Max. Cont.	2·38	56·5

Member Company of the Hawker Siddeley Group

BLACKBURN ENGINES LIMITED
43 BERKELEY SQUARE, LONDON W.1

E. 180

INTO SQUADRON SERVICE

This new addition to the strength of the Royal Navy is the turbine powered Westland Wessex helicopter which is now entering squadron service with the Fleet.

Capable of carrying both detection equipment and offensive armament this aircraft is one of the few helicopters able to handle both the search and strike phases of anti-submarine defence, and modern automatic equipment enables the machine to operate by day or night in all weathers from either ship or shore bases.

As a transport machine it will carry 16 fully armed troops and be capable of placing a striking force direct from a carrier to the centre of operations in a minimum of time.

This helicopter type has completed an intensive flying programme under all conditions prior to going into Squadron Service.

WESTLAND the great name in HELICOPTERS

WESTLAND AIRCRAFT LIMITED YEOVIL ENGLAND
incorporating SAUNDERS-ROE DIVISION, BRISTOL HELICOPTER DIVISION FAIREY AVIATION DIVISION

Air Transport . . . .

(Continued from page 394)

the sea sufficiently rough to increase the elapsed time to five hours.

"I had a look at the airstrip (and I use the word advisedly) which is being constructed on the island of Madeira itself, at Santa Cruz, about 10 miles by road from Funchal. The construction of this strip is in its earliest stages and only a little clearing and levelling has taken place. The building of the strip will necessitate the diversion of the road (where, I don't know!) and the demolition of some property. When completed the single runway will be roughly parallel to the coastline, lying approximately E.-W. At a rough guess, however, I should imagine that a run of no more than 1,200 yd. will be available, suitable only for DC-3-type operations. Probably a feeder link could be operated between Santa Cruz and Porto Santo."

Iranian Merger

A MERGER has been concluded between Iranian Airways (Iranair) and Persian Air Services, and will come into effect on Nov. 2. This move—forecast in our issue for Jly. 22, 1960—has been under discussion for some time; the two companies have always operated in close collaboration. The merged company will operate as United Iranian Airlines (UIA).

Persian Air Services began operations in the mid-'fifties flying freight services between Tehran and Europe. In 1960 a DC-7C was obtained from Sabena, which has assisted P.A.S. technically, and a passenger service was inaugurated, linking London, Brussels, Geneva and Paris with Tehran. More recently, a Boeing 707 has been chartered from Sabena for some of these services.

Iranair is primarily a domestic and regional operator, with a fleet of three Viscounts, two DC-4s and a dozen DC-3s. A route to Frankfurt is also operated.

Rationalizing the Carrier's Liabilities

DR. S. J. KONORSKI *explains some of the principal features and practical implications of the amended Warsaw Convention.*

THE Carriage by Air Act, 1961, is now on the statute book. An Order in Council, which will probably be published shortly, will determine the date when it will come into force. On that day the Carriage by Air Act, 1932, will be repealed and thus the Warsaw Convention of 1929, "for the Unification of Certain Rules relating to International Carriage by Air," will, in its original form, be superseded by its amended version. The latter was finally agreed upon, after years of study, in the framework of ICAO, at the Hague Conference in 1955, and it needed further years of preparatory work in the countries concerned to put the Protocol of the Hague Conference into effect.

The new Act and the amended Warsaw Convention set out in the Schedule to the Act represent, naturally, a highly specialized piece of legislation. But, apart from juridical details, its principal features constitute a matter of considerable interest for non-legal readers conversant with the practical aspects of air transport.

The aim of the Convention—the original as well as the amended one—was the introduction in all participating countries of the same legal provisions dealing in the main with the following three subjects: the documents of carriage; the principles of the liability of the carrier; and the limitation of the liability—the two last points being, of course, closely interconnected.

In respect of the carriage documents of all three categories—namely the passenger tickets, the baggage checks (formerly called the luggage tickets) and the air waybills (formerly called the consignment notes)—the amended Convention has substantially simplified the requirements as to what these documents should contain. These modifications are certain to be welcomed by the air operators as they save a great amount of work.

But the amended Convention has maintained the principle that the carrier will not be entitled to claim limited liability if he has accepted a passenger, or luggage, or cargo, without issuing the relevant carriage document, or if he has issued a carriage document which does not contain certain provisions. So far as the latter case is concerned, however, the carrier would now lose the right to claim the limitation of his liability only if he has failed to insert into the carriage document a notice to the effect that the Warsaw Convention may be applicable if the journey involves ultimate destination or stop in a country other than the country of departure. Formerly, certain other irregularities of the carriage documents also caused the loss of the right of limitation of the liability. No doubt this is an eminently practical innovation, the aim of which is to avoid attaching very grave financial consequences to what may be only a minor negligence in completing the carriage documents.

The principles of the carrier's liability, established in the original Warsaw Convention, have been maintained in the amended version with minor modifications, but one significant change has been made. A provision has been deleted which excluded the carrier's liability if the damage to the cargo or luggage was caused exclusively by the negligence in pilotage, in the handling of the aircraft, or in navigation. This change is in keeping with the higher performance standards expected nowadays from the air carriers.

The general rule that the carrier is not liable if he proves that all necessary measures were taken, or that it was impossible to take such measures in order to avoid the damage, has not been altered, neither has the rule that if an injury suffered by a passenger was caused or contributed to by his own negligence the court may exonerate the carrier partly or wholly.

Dealing with the limits of the carrier's liability, the amended Convention has raised the maximum amount of damages, in case of the death or an injury sustained by a passenger, from 125,000 gold francs (about £2,950 at the present rate) to double that sum, or 250,000 gold francs (about £5,900). The maximum amount of damages in respect of the luggage and of cargo remains unchanged—viz. 250 gold francs (£5 18s.) per kilogram—and so does that pertaining to the objects of which the passenger takes charge himself—5,000 gold francs (about £118) per passenger. New provisions have been added to solve the thorny problem of the liability in case of a loss or damage of part of the luggage or cargo, but the consideration of that matter must remain outside the scope of this article.

An entirely new rule has been added regarding the conversion of the sums expressed in francs, but it has been incorporated in the Act itself and not in the Convention. It applies, therefore, only to this country—and possibly to such territories to which the Act may be extended by Order in Council. From now on the Minister of Aviation will from time to time specify the sums in sterling by order made by statutory instrument.

These are just a few of the most important practical features of the amended Convention. No claim is made that a full account has been given—but a few words should be added about an important issue on which the Warsaw Convention, even in its new version, is silent.

This is the question of the air charter. In the late 1920s, when the original Convention was taking shape, air charter practically did not exist. It has assumed vital importance, particularly in the post-War years. The application of the Warsaw Convention to chartered aircraft poses a difficult dilemma, since there appears, so to speak, to be a split in the person of the carrier.

It is the charterer who is the party to the contract of carriage, who determines the fare, who normally issues the carriage documents and who has the commercial and operational control of the aircraft. But the technical control of the aircraft remains with the operator—in most cases an airline. The personnel of the airline cannot be regarded as the servants of the charterer, since the airline is not a servant either.

Legal opinion tends to regard the charterer as the carrier in the sense of the Warsaw Convention, but this frequently leads to rather doubtful consequences—for instance, substituting the liability for damages of a sometimes impecunious travel agent instead of that of an airline. The Hague Conference of 1955 was very much aware of the significance of the problem of the application of the Warsaw Convention to air charter, but it came to the conclusion that "the matter is of too great complexity to permit the insertion of provisions relating thereto into the Protocol to amend the Warsaw Convention," and recommended ICAO to study the subject further.

Not so long ago, the Legal Committee of ICAO adopted a draft of a new convention which should prove to be a satisfactory solution of this intricate problem. It appears to be a major achievement in this branch of the air law.

The Fighting Services

Air Rank Promotion

AIR MARSHAL SIR HUGH CONSTANTINE, K.B.E., C.B., D.S.O., has been promoted to the rank of Air Chief Marshal. A.O.C.-in-C. Flying Training Command since March, 1959, he is to become Commandant of the Imperial Defence College on Sept. 25.

He was commissioned from Cranwell in 1927 and throughout the War he served in Bomber Command; he took part in the first thousand-bomber raid. By 1945 he was commanding No. 5 (Bomber) Group. He then became Chief Intelligence Officer at H.Q., British Air Forces of Occupation, Germany, and in 1946 took the Imperial Defence College Course.

From 1948 until his appointment to SHAPE as Deputy Chief of Staff (Plans and Policy) in 1956 he held the positions of Deputy Director of Organisation (Forecasting and Planning) at the Air Ministry, S.A.S.O., No. 205 Group in the Canal Zone, and A.O.C. No. 25 Group, Flying Training Command.

"Ark Royal" Recommissions

AFTER a six-month routine refit, H.M.S. "Ark Royal," largest of the Royal Navy's seven aircraft carriers (displacement 43,340 tons), recommissioned at Devonport on Sept. 12. Following a period of post-refit trials she will sail for the Mediterranean station with four squadrons embarked.

These are No. 800 Squadron equipped with Scimitars (Lieut. Cdr. A. Mancais); No. 890 Sqn., Sea Vixens (Lieut. Cdr. A. Monsell); No. 849 Sqn., Gannet AEW.3s (Lieut. Cdr. A. Bishop); and No. 815 Sqn. (Lieut. Cdr. A. L. L. Skinner), the first squadron to be equipped with the Wessex HAS.1. This last Squadron was commissioned at R.N.A.S. Culdrose in July where it has been working up to operational status.

In command of "Ark Royal"—now equipped with modified steam catapults, the most powerful fitted to an R.N. carrier—is Captain D. C. E. F. Gibson, R.N. His association with the carrier goes back to the previous ship to bear this name when he was a Fleet Air Arm pilot during World War II. He has more than 3,000 flying hours to his credit.

Once fully operational in the Mediterranean, "Ark Royal" will have on board some 2,300 officers and men.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Wg. Cdr. G. F. Morley-Mower, D.F.C., A.F.C., and Sqn. Ldr. D. Gray, A.F.C., with the acting rank of Wg. Cdr., to the Department of the Chief of the Air Staff; Wg. Cdr. P. H. Reason, with the acting rank of Gp. Capt., and Wg. Cdr. F. H. A. Campbell, M.B.E., to the Department of the Air Member for Personnel.

Bomber Command: Wg. Cdr. H. K. Rees, to No. 148 Squadron, R.A.F. Marham, to command.

Fighter Command: Wg. Cdr. J. Rennie, to Headquarters for air staff duties.

Coastal Command: Wg. Cdr. R. B. Roache, D.F.C., to No. 201 Squadron, R.A.F. St. Mawgan, to command.

Flying Training Command: Wg. Cdr. B. G. Lock, A.F.C., to No. 3 F.T.S., R.A.F. Leeming, as Chief Instructor.

Technical Training Command: Gp. Capt. C. H. Wiggins, O.B.E., to R.A.F. Records Office as Officer in charge of the Manning Division; Wg. Cdr. R. M. Martin, as Personal Staff Officer to the Inspector-General of the R.A.F.

R.A.F. Germany: Wg. Cdr. G. E. S. Bumstead, to Headquarters, as Senior Ground Defence Staff Officer; Wg. Cdr. W. Smith, O.B.E., to Headquarters for staff duties.

Air Forces Middle East (Aden): Sqn. Ldr. J. D. Edwards, to Headquarters for staff signals duties, with the acting rank of Wg. Cdr.

Far East Air Force: Wg. Cdr. A. S. Mann, D.F.C., to R.A.F. Kai Tak, to command.

"Checkmate" Participants

BOMBER, Fighter and Coastal Commands of the R.A.F., with logistic support from Transport Command, took part in Exercise "Checkmate" held from Sept. 12-14 as one of a series of routine training exercises designed to perfect the defensive capabilities of NATO's land, sea and air forces.

During the three-day period three elements from Bomber Command—the strategic bomber force, the SACEUR-assigned Valiant squadrons and the reconnaissance force—flew sorties over Western Europe to provide practice for the air defences. Fighter Command deployed the Javelin FAW.9s of No. 29 Squadron from their base at Leuchars to Oerland, Norway, and the Hunter F.6s of No. 19 Squadron, normally based at Leconfield, took up temporary residence at Skydstrup, Denmark. Home-based squadrons made simulated attacks in North West Europe.

Shackletons from No. 203 Squadron, Ballykelly, operated from Andoya, Norway.

More Service News

North American Visit.—Two Shackletons of No. 201 Squadron, Coastal Command, based at R.A.F. St. Mawgan left for Canada and the U.S.A. on Sept. 11, for a liaison and training visit. Leading the detachment was Air Vice-Marshal L. W. C. Bower, A.O.C. No. 19 Group. The aircraft were to spend a week at R.C.A.F. Comox, Vancouver Island, taking part in maritime air exercises. On the return journey the A.O.C. will call at the U.S. Naval Air Station at Norfolk, Virginia, in order to visit Admiral R. L. Dennison, NATO Supreme Commander, Atlantic.

Trophy Winner.—Flt. Sgt. P. Maloney, who with S/Sgt. Instructor M. Evans of the Parachute Regiment, reduced the trans-United States walking record from 79 to 66 days in 1960, has been awarded the R.A.F. Escaping Society Trophy. This is presented annually for the best individual feat of combat survival by a member of the R.A.F. during operations or training. In its recommendation, the Committee described the walk as "a remarkable feat of endurance against variable climatic conditions, physical hardships and fatigue." "Although not a walk for survival," it added, "Flt. Sgt. Maloney's example must rank high in comparison with previous outstanding achievements against adversity—when survival was of paramount importance."

M.R.E.S. Officers' Reunion.—This year's M.R.E.S. officers' reunion will be held in London on Saturday, Oct. 28. For full particulars, write, enclosing a stamped addressed envelope, to Sqn. Ldr. P. E. Laughton-Bramley, M.B.E., Haldon, Nightingale Avenue, West Horsley, Surrey.

No. 55 Squadron Reunion.—Eighth annual reunion of No. 55 Squadron is to be held at The Peacock, 14 Maiden Lane, Covent Garden, London, W.C.2, on Saturday, Oct. 21 from 18.30 hrs. onwards. Tickets, price 7s. 6d., and further details are available from Mr. Ivor Calverley, 38 Pondfield Crescent, St. Albans, Herts.

ANNIVERSARY EXHIBITS.—The scene at Richmond Terrace, Whitehall, last week showing part of the outside exhibition staged by the Air Ministry to commemorate the 21st anniversary of the Battle of Britain. In this picture are seen one of the two Spitfires on display, a Hurricane, Javelin and Hunter. On the left is a Bloodhound SAM.

Photograph copyright "The Aeroplane and Astronautics"

Wilbur Wright Memorial Lecture

Research for Space Flight

For the first time a Wilbur Wright Memorial Lecture has dealt with space technology. Here, some of the main points made by the distinguished speaker—DR. ABE SILVERSTEIN, of NASA—have been summarized.

PRINCIPAL event in the Royal Aeronautical Society's lecture season, the Wilbur Wright Memorial Lecture, is customarily taken as an opportunity for presenting results of original research carried out in the aeronautical sciences. The 49th such address given by Dr. Abe Silverstein, Director of Space Flight Programs at NASA, during the 8th Anglo-American Aeronautical Conference in London on Sept. 12, deviated from this tradition to the extent that it dealt with aerospace problems.

Dr. Abe Silverstein.

Under the title of "Researches in Space Flight Technology," Dr. Silverstein covered a broad canvas—from propulsion to aerodynamics and structures — mostly drawing upon experience gained by NASA. His intention, he said, was to arouse interest in the problems involved and "perhaps invoke the participation of others in helping to solve them."

In view of the comprehensive nature of this paper, it is impossible here to do more than touch on a few of the stimulating topics discussed, which began with a survey of research in the field of space flight propulsion.

"The burden of providing increased space flight capability for the future, as it has in aircraft development, falls most heavily on the shoulders of those responsible for the development of the propulsion and associated launch vehicle systems," the speaker said. "The higher the total velocity to be imparted to the spacecraft, the greater is the premium on high propulsive performance."

"In the lunar landing and return mission in which a total velocity of about 56,000 ft./sec. is required," he went on, "a multi-stage, all-solid-fuelled rocket vehicle may require as much as 40 million lb. thrust in the first-stage rocket, and the launch vehicles may weigh 25 million lb. In contrast, a three-stage launch vehicle with liquid propellent first and second stages, and a nuclear heat exchange rocket as a third stage, can accomplish the same mission with about 0.1 of this launch thrust and weight."

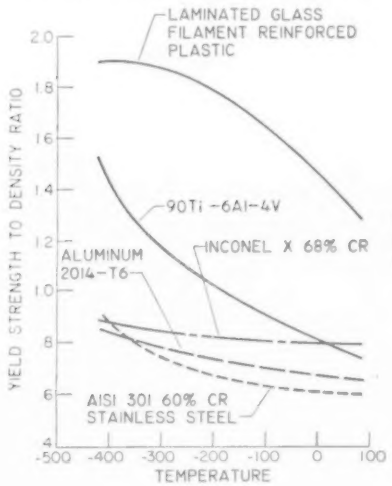


Fig. 1. Material strength-to-density ratio as a function of temperature.

Many analytical investigations have shown the large gains in performance possible from the use of liquid hydrogen either in combination with liquid oxygen or fluorine in a chemical rocket or used as the propulsion fluid in the nuclear powered rocket.

To make available this high performance with liquid hydrogen for advanced missions, NASA has initiated development of a 15,000-lb.-thrust rocket engine, a 200,000-lb.-thrust engine, and in a co-operative effort with the United States Atomic Energy Commission, a heat transfer nuclear rocket engine.

The use of liquid hydrogen as a fuel, with its temperature of 425° F. below zero, a density only 1/15 that of water and a coefficient of expansion 10 times that of most liquids, introduces a host of challenging research problems associated with its tankage, insulation and storage in space, pumping, and the location of the liquid and vapour in the tank during the weightless period of flight.

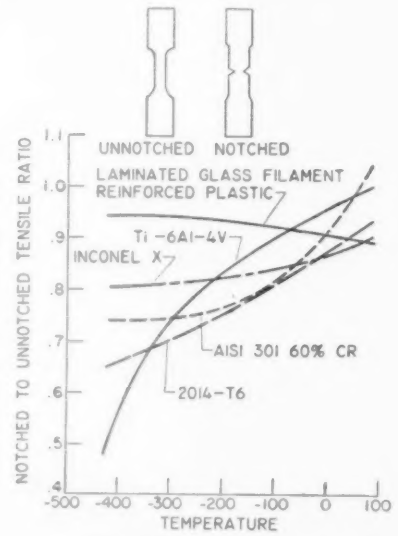


Fig. 2. Notch sensitivity of various materials as a function of temperature.

Materials for tanks storing liquid hydrogen must have a high strength-to-density ratio and be insensitive to stress concentrations due to minute notching or cracking of the material. In initial developments, stainless steel has been used to provide these properties. Unpublished results of research at the NASA Lewis Research Center are shown in accompanying diagrams for a series of metallic tank materials and for a plastic resin tank material with glass fibre filaments incorporated for reinforcement.

All of the tank materials showed improved tensile yield strength-to-density ratios at low temperatures for the unnotched conditions (Fig. 1) but only the plastic tank showed improved characteristics at low temperatures in the notched condition. Despite its good low-temperature tensile properties, the practical problems of fabricating the plastic-glass reinforced tanks in the large sizes required for the low-density hydrogen, the problem of tank wall permeability, and the relatively low compressive strength of the material, may prevent its use.

The problem of storing the high-impulse cryogenic liquid in

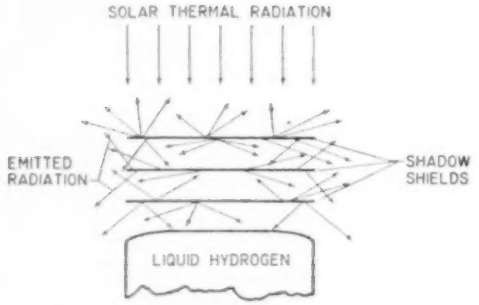


Fig. 3. Radiation to and from shadow shields.

space or close to the Moon or planets for long periods of time without undue propellent evaporation losses, and without severe weight penalties for insulation, is currently receiving heavy emphasis. Storage time will depend on the mission, being a week or weeks for lunar missions and possibly months or several years for the planetary or interplanetary flights.

In a comprehensive examination of solar and planetary heatings of cryogenic propellents in space, and an unpublished review of the data by Dr. R. J. Brun of NASA's Lewis Research Center, widely spaced reflector surfaces (shadow shields) were found to be very effective in reducing propellent heating from the Sun. Ten shields of the type shown in Fig. 3 were found to reduce the heat absorption rate of the hydrogen through the end of the tank from 1,000 B.Th.U. per day per sq. ft. for a bare tank to 0.1 B.Th.U. per day per sq. ft. for the shielded tank. The spacing between each shadow shield was assumed as 0.01 of the shield diameter and the absorptivity and emissivity of all surfaces was assumed to be 0.1.

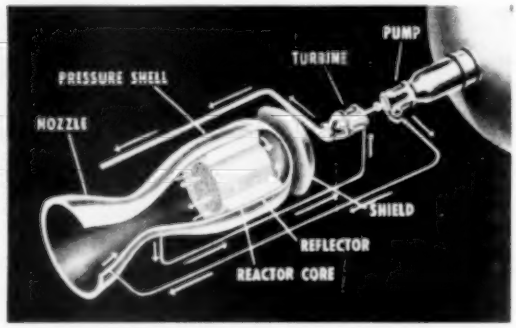


Fig. 4. Nuclear rocket engine.

As the spacing between the shields is increased, more heat can be radiated to outer space from each shadow shield (Fig. 3) so that the same heat absorption of 0.1 B.Th.U. per day per sq. ft. is obtained with 30 shadow shields 0.001 diameter apart or from four shadow shields 0.1 diameter apart. Difficulties with supporting the shadow shields at a distance from the tank surfaces has led to the search for other forms of radiation protection.

One method is to stack the reflecting surfaces in a blanket in which they are separated only by thin glass fibre mats or paper. Over 100 metal foils plus the separators have been stacked per inch of blanket thickness. With this close spacing the foils cannot radiate to outer space and the heat absorption into the liquid hydrogen increases to about 5 B.Th.U. per day per sq. ft. of tank-end facing the sun.

This technique appears more promising than shadow shielding when the vehicle cannot be orientated to face the Sun, or when it is in the vicinity of the planets and exposed to their radiation. Shield installations then become awkward since protection is required on all surfaces of the tank.

The multifoil technique appears to offer considerable promise for long-term protection of hydrogen in space, but many problems yet remain to be solved. Suggestions have been made for improving the effectiveness of the multifoils by use of surface coatings with a low solar absorptivity. By a combination of properly designed radiation shields, by orientation of the vehicle so that the engine faces the Sun, and by arranging the tanks properly behind the engine, calculations indicate that the hydrogen loss in space due to thermal radiation from the Sun can be reduced to a value as low as 0.003% per day.

In this section of his paper, Dr. Silverstein also discussed the research programmes which NASA is conducting into micrometeoroids, which may present a hazard from the viewpoint of long-term storage of propellents in space through the puncture of the containing tanks. He described in detail the S-55 satellite which has been developed expressly to telemeter results of micrometeoroid impacts to Earth (THE AEROPLANE AND ASTRONAUTICS, Sept. 7, 1961, pp. 338-9).

In order to determine the damage associated with meteoroid impact, the speaker said, it was considered that damaged space vehicles must be recovered and examined on the ground. Experiments to obtain these results are now being planned. Laboratory experiments are already being made, using high-velocity guns and projectiles. "The projectiles were impacted on a variety of simulated vehicle surfaces in an attempt to assess damage and determine preferred skin designs that might absorb the impact energy or sustain minimum damage."

Turning to the problems introduced by flight under weightless

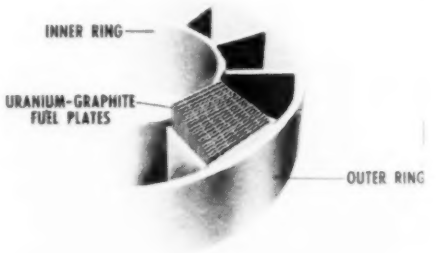


Fig. 5. Kiwi-A graphite support and fuel plates.

conditions, Dr. Silverstein next reviewed tank venting, pressurization, pumping, and engine re-starting with particular reference to questions concerning the distribution of propellent and propellent vapours. This, in turn, led to consideration of nuclear rocket propulsion.

The Atomic Rocket

From theoretical considerations, it can be shown that the specific impulse practicable from the most energetic chemical combinations is less than 500. The nuclear rocket offers the possibility of specific impulse values exceeding 1,000, which emphasizes the interest which surrounds this type of engine. Fig. 4 illustrates a typical system.

The hydrogen is stored as a liquid in the propellent tank and is at a temperature of about −422° F. at the entrance to the double-walled exhaust nozzle. After cooling the nozzle walls, the hydrogen cools the reflector of the reactor. The reflector is used to conserve the neutrons which are required to produce the fission process.

The reflector, therefore, helps to reduce the size of the reactor core and the amount of uranium that is required in the reactor. The hydrogen then passes through the reactor core where it comes in contact with fuel elements that are loaded with the uranium fuel. The capture of neutrons by the uranium causes fission of the uranium nucleus releasing the large fission heat energy.

This fission heat energy is transferred to the hydrogen flowing through the reactor past the fuel element. After being heated in the reactor, the hot hydrogen gas is then accelerated through the nozzle producing thrust.

The development of the technology of the nuclear rocket is

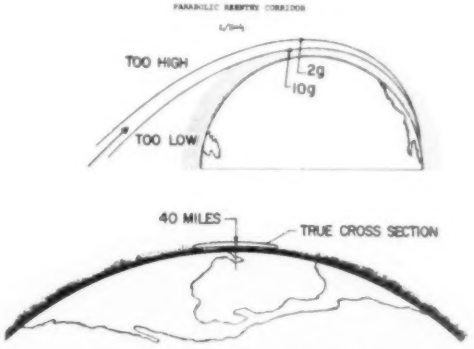


Fig. 6. Parabolic re-entry corridor.

already under way in a joint AEC-NASA ROVER programme. As part of this programme, reactors will be developed to operate at temperatures above 3,500° F. with hydrogen as a propellent. Work is also in progress on the development of the other principal components of the nuclear rocket engine system such as the pumps, nozzles, controls and shields.

A major step forward in the programme was taken when three research reactors were tested in the summer of 1959 and the summer and autumn of 1960 by the Los Alamos Scientific Laboratory. These reactors were called the KIWI-A, the KIWI-A prime, and the KIWI-A3.

The first reactor tested in July, 1959, the KIWI-A, used a flat plate graphite fuel element arranged as shown in Fig. 5. The fuel element plates were inserted into an unloaded graphite support structure. Each of these plates was 0.25 in. thick and was loaded with U-235. The ribs on each plate were 0.050 in. high and acted as spacers between the adjacent plates. Hydrogen gas passed through this clearance space and was heated as it flowed through the reactor.

A heavy water (D_2O) island was located within the inner ring of this wheel-like support structure. The control rods required to regulate the fission rate and, therefore, the power of the reactor, were located in this central heavy water island.

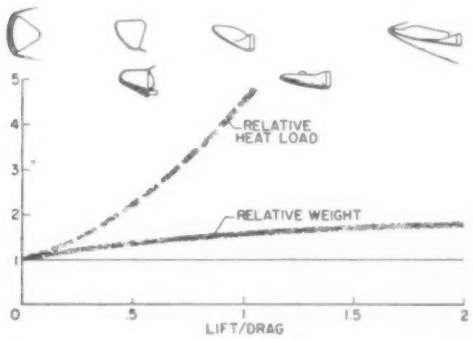


Fig. 7. Manoeuvrability increases heating and weight.

The external appearance of all three of the reactors tested was essentially the same. The reactor core geometry was different, however, in the later tests from the one used in the KIWI-A reactor. Hydrogen gas rather than liquid hydrogen was used as the propellent in these first tests and water rather than hydrogen was used to cool the jet nozzle and the pressure shell.

The results of all these tests were extremely encouraging in helping to evaluate the materials used and design procedures, and in establishing confidence in the test conditions for the high temperature systems. A second test series will start later this year, including the use of liquid hydrogen as a propellent.

Re-entry Problems

The next of Dr. Silverstein's themes was related to aerothermodynamics, which led to consideration of the re-entry corridor for space vehicles returning to the Earth's atmosphere. The corridor width for acceptable re-entry, the speaker said, varies from seven miles for the ballistic capsule such as Mercury to 40 miles for a spacecraft with a lift/drag ratio of 0.5 and up to about 60 miles with a lift/drag ratio of 3.0. A scale drawing of the actual cross section of the corridor for an L/D of 0.5 is shown in Fig. 6.

With L/D of 0.5, if it were possible to position the spacecraft precisely near the upper side of the corridor, the use of lift would permit re-entry with as little as $2g$ maximum deceleration. The aerodynamic forces can also be used to manœuvre the spacecraft to a preselected landing site regardless of initial navigational errors that do not exceed the allowable corridor width.

The increase in spacecraft weight and heat load with increasing values of L/D ratio (Fig. 7) emphasizes the desirability of selecting design values of lift/drag as low as are acceptable to meet the manœuvrability requirement. Studies indicate that values of L/D in the range of 0.5 to 1.0 meet these requirements for a parabolic re-entry. The configurations for this range of L/D values are generally blunt compact shapes that provide for good utilization of their internal volume.

Recently, the NASA Ames Research Center introduced a new technique for measuring heat transfer rates in free flight in a ballistic range which provides the possibility of correctly

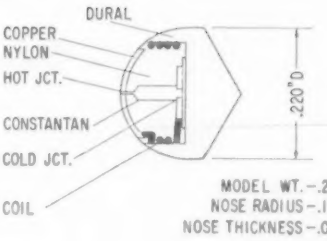


Fig. 8. Thermocouple model.

simulating Mach number, stagnation enthalpy and Reynolds number for some trajectories of interest.

The models launched in this ballistic range (Fig. 8) consist of a hemispherical nose with a short cylindrical section and a 120° conical tail. The model is made of aluminium and has a 0.0075-in. thick copper cap on the nose. This acts as a calorimeter heat gauge.

A constantan wire is soldered to the cap of the stagnation point of the model which forms the hot junction of the copper constantan thermocouple. A four-turn coil wire on a boron nitride form is connected between the two junctions of the thermocouple at the disc in the centre of the model and at a point on the periphery of the nose cap. To permit computation of temperature rise, the electrical resistance of the complete circuit is accurately measured before final assembly.

The experimental set-up consists of a pick-up coil made of coated copper magnet wire. This entire coil is shielded in an electrostatic Faraday cage.

As the stagnation point is heated during the flight of the model, the resulting potential difference between the hot junction and the cold junction causes the current to flow in the model coil, thus producing a magnetic field around the model. This magnetic field, in turn, induces an e.m.f. on the pick-up coils located along the trajectory of the model. There are six pick-up coil stations.

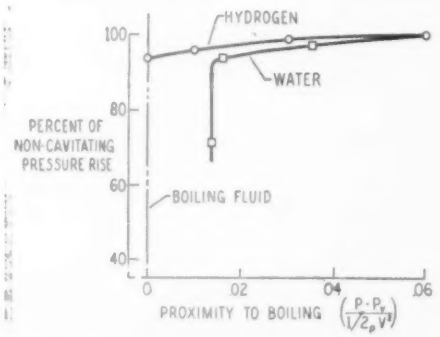
The output of these coils is then fed to an oscilloscope. Using the resultant temperature/time data and assuming the heat flow is one dimensional, the heat transfer rate is computed at the stagnation point.

The potentiality of the system described here lies in two directions. The Mach number and Reynolds number can be varied independently and heat transfer measurements can be made near the base of the model without fear of interference of the supporting structure. This, of course, will require further development of the experimental technique.

Dr. Silverstein stressed, however, that the method he had outlined was limited to small-scale models and simulation over the afterbody; in the vicinity of control flaps large-scale flight tests would still be necessary.

Structural Considerations

On the subject of materials, the lecturer outlined the problems entailed in re-entry heat shields, laying particular stress on the class of ablating materials composed of phenolic resins and plastics which may be important for re-entry at parabolic velocities. His subsequent discussion of structures ranged from the 100-ft. Mylar balloon-satellite (skin thickness 0.0005 in., total weight 123 lb.) to the dynamic loading and structural problems associated with large rocket vehicles. The latter embraced such questions as fuel sloshing, interactions between the elastic vehicle frame and the controls, and troubles arising from wind gradients and wind shears.—K.W.G.



Particular attention is being paid to the design of pumps for the liquid hydrogen rocket engine system. This graph shows the performance of such a pump.

Flying the Procaer Picchio

No. 105 in the Series by John Fricker

ING. STELIO FRATI, the Italian designer, has produced a series of remarkable and efficient light aeroplanes that deserve to be more widely known. One of them, the two-seat F.8L Falco, was reviewed earlier in this series (No. 61, THE AEROPLANE AND ASTRONAUTICS, Oct. 9, 1959), and its four-seat development, the F.15 Picchio, is now being marketed in this country and nearly everywhere throughout the World by Mexfield Aviation Co., Ltd., of 31 Palace Gate, Kensington, W.8.

Like its two-seat predecessor, the Picchio is sheer delight to fly, and yet on its 180-b.h.p. Lycoming O-360-A1A engine it is claimed to out-perform every comparable American type with a similar powerplant. It has considerably less wing than any of its transatlantic competitors, but has a slower stalling speed and, therefore, shorter take-off and landing runs. It is as viceless as any high-performance light aeroplane can be, and its margin of safety is very considerably enhanced in that it is built to aerobatic load factors.

Its advantages do not end there. It is quite definitely designed as a grass-field aeroplane, with an exceptionally soft and well-sprung oleo tricycle undercarriage, and its cabin is roomier than the average four-seat tourer. Flight visibility, too, is exceptionally good, and the Picchio emphasizes, perhaps more than any other type, the differing concepts of the European "pilot's aeroplane" and the American "flying vehicle."

Many of the Picchio's qualities stem from the fact that it is craftsman-made, by the Procaer company in Milan, of wood—that light, very strong, fatigue-proof but now outmoded material for large-scale production. Only recently has the last American lightplane manufacturer abandoned wooden wings for its laminar-flow design because of its mass-production shortcomings; whereas the U.S. types are built in their hundreds and thousands, Picchio production has only just reached three figures since it began in 1959.

Developed from the Aeromere-built two-seat Falco, the Picchio was first produced as the F.15, with accommodation for three people; it had a span of 30 ft. 7 in. and a 160-b.h.p. Lycoming engine. Fifteen of this version were built before the higher-powered Lycoming O-360 was installed, and the airframe given a four-seat capability as the F.15A. After 54 of the earlier version, the Picchio became a full four-seater with the introduction of the F.15B (35 built to date, at one per week), which dispensed with the extra fuselage fuel tank in favour of larger twin mainplane cells having a total capacity of 40 Imp. gal., and also had an increase in span of 7 ft. to bring the wing area up from 131.5 to 144 sq. ft.

Apart from replacement of the upward-hinging starboard door by a forward-opening type, the sleek and eminently eyeable airframe of the Picchio was otherwise unchanged, and retained its unique metal-clad wooden structure. This Procaer development consists of covering the wooden airframe with prefabricated ply panels plated with a special aluminium alloy (Peralluman 45) particularly resistant to corrosion.

Since the internal structure is protected by special synthetic varnishes, this method of construction combines many of the advantages of wood and metal techniques. It results in a spectacularly smooth finish for the Picchio's sleek and rakish fuselage, and laminar-flow NACA 64.15/10 wing.

With the fluid grace of its smoothly flowing lines, the Picchio has a thoroughbred air, even when poised on its wide-set tricycle undercarriage. The close attention paid to perfect streamlining is exemplified by the closely cowled Lycoming and NACA-type flush intakes for cabin ventilation. For all that, however, the aft-folding nosewheel protrudes from its stowage when retracted, as is the case with the smaller Falco, presumably to give some belly landing protection.

Cabin access in the Picchio could be easier. There is no step to aid the tight-skirted on to the wing root, although this is commendably close to the ground. The small entrance door does not seem to be provided with a stay to hold it open, and as the front seats do not slide back very far it is necessary to step on them or over them before sitting down. Rear-seat access is quite simple.

Inside, the Picchio is unexpectedly roomy, and the cabin ceiling looks lower than it actually is because of the width available. Actual dimensions of the cabin are 9 ft. in length, 3.62 ft. in width and 4.1 ft. in height, which presumably includes the baggage compartment behind the rear seat. There is ample space for up to 90 lb. of luggage, but the Picchio falls below accepted practice in not having an external access door to this compartment.

About nine inches separate the individual front seats, which are adjustable for leg length, behind the sharply bowed dual control columns and pendulum-type rudder pedals. The odd shape of the sticks, which are surmounted by circular grips, is probably to facilitate access to the front seats, but it would be better if the Picchio conformed to accepted transatlantic touring standards in providing push-pull wheel controls. The sticks are comfortable enough and could be offered as optional equipment for the aerobatically inclined.

One other comment on the instrument and control layout of the Picchio, which is otherwise more or less standard, seems appropriate. Braking is non-differential, since the nosewheel is steerable, from a long lever tucked away on the extreme left of the cockpit. This lever would be far more conveniently situated below the centre of the deep instrument panel, available to both front-seat occupants and close to the vernier-type throttle plunger for manipulation by the same hand.

Only in the quality of its internal furnishings does the Picchio fall short of accepted American standards, and although it is by no means shoddy, a good stylist could work wonders with the excellent layout available. The absence of refinement is also apparent from the rather high noise level in the cabin, on starting the Lycoming, as well as from the transfer of engine heat into the cockpit. Both point to the need for more insulation and a thicker windscreen might also help, since most of the noise seems to emanate from the Hartzell variable-pitch airscrew.

Powerful blasts of outside air are available round the legs

from the side ventilators, which leak fairly substantial draughts when closed. The air-conditioning system includes windscreen demisters which somehow managed to spray oil on the inside of the sharply raked front screen. This may have been due to the fact that G-ARNV was a brand-new aeroplane and had only recently been flown from Milan (reaching Paris in about 3 hr.).

I made about half a dozen flights in the F.15B demonstrator, including short cross-countries from Denham to Sywell and back, and I was most impressed with it as an aeroplane. With full fuel and three male adults on board, plus some heavy baggage, it got out of Denham's tree-encircled area with very little bother, unsticking at about 60 knots with the aid of half-flap (20°). This was selected by the three-position manual flap lever between the front seats, behind the fuel cock for one or other of the wing tanks.

Foot loads for the steerable nosewheel were rather heavy during taxi-ing and take-off, fairly substantial right rudder pressure being required at full power of about 30 in. Hg and 2,700 r.p.m. Slight aft stick movement was sufficient to take the weight off the nosewheel as the Picchio rode gently along on its soft oleos, and a blip or two of stall warning horn during unstick warned against pump-handling the powerful elevator.

The crispness and response of the Picchio controls were immediately apparent on becoming airborne, but they have nothing of the slightly "knife-edge" nervousness of the smaller Frati designs, and are appropriately more solid in feel. Ailerons, elevator and rudder seem to be co-ordinated within a hair's-breadth of each other, with directional control perhaps just a shade too light for non-Latin tastes. This is, perhaps, more noticeable because of a slight tail-wag tendency of the Picchio in rough air, of which there was plenty during my flights.

There was also quite a lot of rain, too, which, I was intrigued to see, the sharply raked front screen shed surprisingly well, so that the excellent all-round cabin visibility from the Picchio remained unimpaired. Heavy rain did not penetrate the cabin either, so that wherever else the noise is coming from it is not through the door or window seals.

Apart from its directional quirk, which may not have been representative because of a dented rudder, the Picchio showed largely neutral stability characteristics laterally and longitudinally. Coupled with the potent controls, these account for its fighter-like handling, while it is additionally blessed with unusually mild trim changes throughout all conditions of flight.

This is apparent on raising the undercarriage, via its electric selector switch, immediately after take-off, when the only evidence that the slightly prolonged process is going on is a brief yaw as the mainwheels fold inwards with a little differential. Raising flaps helps acceleration and attitude towards the optimum climb at 85 knots when, solo, the Picchio indicated more than 1,200 ft./min. The flight manual gives the rate of climb at 10,000 ft. at max. gross of 2,470 lb. as 440 ft./min., so that the Picchio certainly gets up and goes.

I did not aerobat G-ARNV—which is fitted only with lap straps, although having provision for full harness—during my flights, but the prospect is tempting. I estimated the rate of roll at about 90°/sec., which is up to some jet fighter standards, and the elevator force seems to be about 8 lb. per *g*. Translated into everyday terms, this adds up to an aircraft considerably more responsive than most currently imported, and requiring correspondingly less effort to fly.

Despite its potency, or perhaps because of it, it is easier to fly than some comparable types. The slightly higher wing loading means that you do not get thrown about so much in turbulence, and once you touchdown on landing there is no tendency to balloon. The usual penalty associated with these characteristics is a less-forgiving aeroplane, but this does not seem to be the case with the Picchio.

I approached its low-speed handling with some diffidence in view of the limited height available during my tests, but on closing the throttle to try a clean stall I found as an initial response that I gained a couple of hundred feet. As I continued moving the stick back gently at a fairly constant rate the ailerons remained effective to keep the wings level until, with about two-thirds aft elevator, when solo at a forward C.G., a brief buffet nodded the nose in and out of a stall. Lateral control remained throughout, the minimum speed of about 55 knots having been heralded long before by aural warning.

By continuing to move the stick back during the breakaway, a developed stall brought the port wing down fairly smartly with little or no warning, but also without losing a great deal of height. About 200 ft. was lost during the second exploration, which subsequently included unsuccessful attempts to flick out of a slow gliding turn.

With undercarriage and full 40° of flap down (below 100 knots), and aft trim wound on by the little low-geared handle in the roof, plus a trickle of power, stalling characteristics were generally similar, also without aerodynamic warning, and at a speed of around 50 knots. There was nothing to choose, on this evidence, between the stall of the Picchio and any other comparable touring aeroplane, nor should there be since it has a very similar wing section to both the Mooney Mk. 21 and the Piper Comanche.

Its cruising performance, in I.A.S. at around 2,000 ft., I found to be about 130 knots (150 m.p.h.) at a conservative power setting of 23 in. Hg and 2,350 r.p.m. This would be about 55% power, whereas at 24 in. Hg and 2,450 r.p.m. the T.A.S. at 6,000 ft. becomes just a fraction under 170 m.p.h. It is possible to get the Lycoming down to less than 8 gal./hr. in these conditions, giving at worst an a.m.p.g. of more than 21. Never-exceed speed is a high 195 knots.

Getting into Denham over the tall trees fringing its north-eastern boundary was an interesting exercise in the Picchio, although with 900 yd. run available there was more room than there seemed, despite the light wind. As a precautionary move, with full flap and undercarriage lowered, I wound full aft trim to hold the approach speed of about 80 knots and then opened up to full power to check the overshoot. It was not even necessary to touch the stick, so small was the change of trim, although the little roof crank was quite effective at cancelling out the small residual stick forces.

The slotted flaps of the Picchio are more effective than average in steepening the glide, and on throttling back over the trees it was necessary to stuff the nose well down to maintain speed before the decisive flare-out and gentle touchdown. The weight could be held off the nosewheel with full aft stick, and braking was not necessary to stop within about two-thirds of the available distance. With the flatter approaches of Sywell, I kept on a little power and let the speed fall to about 70 knots for the most undemanding of arrivals.

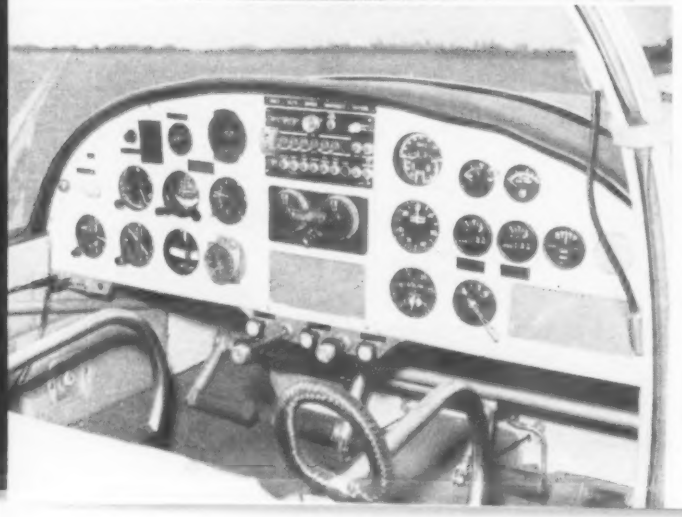
If ever there was a sheep in wolf's clothing it is the Picchio, and with its outstanding performance and handling Procaer should give considerable thought to its refining where creature comforts are concerned. Its equipped U.K. price of £8,900, including duty, Narco Mk. V VHF, night-flying gear and electric gyro instruments, is very little more than its less scintillating competitors, and it has enough additional qualities to beat the Americans at their own game.

Leading Particulars

Dimensions—Span, 37 ft. 2 in.; length, 24 ft. 8 in.; height, 9 ft. 2 in.; wing area, 144 sq. ft.; track, 9 ft. 2 in.

Weights.—Empty, 1,530 lb.; four persons, 640 lb.; max. fuel and oil, 300 lb.; max. gross, 2,470 lb.

Performance.—Max. speed, 184 m.p.h.; cruising speed, 70% power at 10,000 ft., 171 m.p.h.; initial climb, 950 ft./min.; service ceiling, 16,900 ft.; time to 10,000 ft., 15 min.; max. range at 10,000 ft., 1,000 miles; endurance at 137 m.p.h., 7.3 hr.; take-off to 50 ft., 1,680 ft.; landing from 50 ft., 1,410 ft.



Photographs copyright "The Aeroplane and Astronautics"

External recognition points of the F.15B Picchio are its ribbed-metal control surfaces, NACA ventilating intakes and forward-hinged door. Inside, the Picchio is spacious and comfortable, with ample room for central navigation and radio equipment.

R.Ae.S.—I.A.S.—C.A.I. Symposium

A Concentrated Conference

LAST week, some 600 delegates from 12 countries attended the technical sessions of the eighth Anglo-American Aeronautical Conference at 4 Hamilton Place. These affairs have been organized since their inception jointly by our own Royal Aeronautical Society and America's Institute of the Aerospace Sciences; more recently, however, a third partner—the Canadian Aeronautical Institute—has come to take a share of the organization.

It is interesting to note that, whereas in the past the subjects dealt with at these affairs have tended to range over the whole gamut of possible aeronautical topics, this time there was a concentration on three main areas. These were, significantly enough, the pressing problems of supersonics, the important techniques of vertical take-off and landing, and the new technology concerned with aerospace affairs.

Perhaps it is even more significant that for the first time the Wilbur Wright Lecture—Britain's premier event in the aeronautical lecture season and a highlight of Conference—has dealt with space technology. A summary of the main points made in Dr. Abe Silverstein's most interesting paper is given on pages 397-399.

Discussing SST Problems

Both the design and operational aspects of the coming generation of supersonic civil transport aircraft received detailed attention in the papers covering this particular subject. Three of these lectures are summarized here, together with some quoted points from a paper dealing with a remarkable new form of powerplant for hypersonic speeds.

General Aspects of Supersonic Transport Aircraft

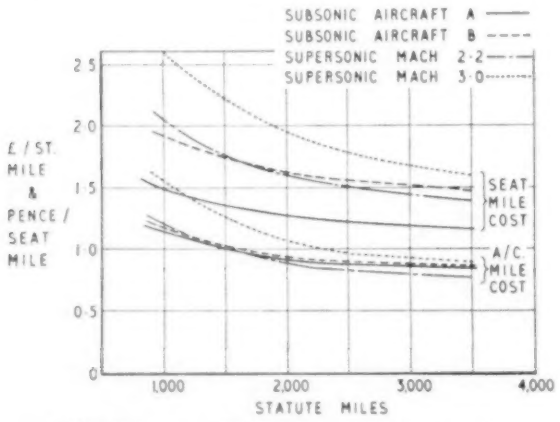
One of the most controversial issues over SSTs has been whether such aircraft should be designed for Mach 2 or Mach 3. This paper by DR. A. E. RUSSELL, *director and chief engineer of Bristol Aircraft, Ltd., compares the two possibilities and makes the case for Mach 2.*

For speeds in the neighbourhood of M=2, extensive wind tunnel work has demonstrated the superiority of the slender tail-less delta. At speeds close to M=3 and above, the canard delta offers the best result. Both of these solutions are competitive when judged by aerodynamic criteria and designs so based need comprehensive analysis to assess their merits.

It is a coincidence that slender deltas become unsuitable at about the same design speed as aluminium alloys cease to be appropriate for the structure.

The use of titanium has certain attractions but there is little previous experience of its use in civil aircraft and it is expensive. The extra cost involved by the complete adoption of titanium for the main structure may approach £1m. per aircraft.

The use of many non-metallic materials in supersonic transports gives rise to great concern. Replacement at intervals is only possible in some applications. As temperatures rise towards M=3, unless new polymers and ceramics can be developed, new mechanical solutions will be necessary.



Aircraft cost per mile (£) and seat mile cost (pence).

At the temperatures prevailing around Mach 2 it is possible to use the standard kerosene fuel normally used for present turbine engines. This fuel may be carried in wing tanks in which only very simple measures are adequate to keep the bulk temperature from rising above 70°C. Gumming in the system will not occur at temperatures below 90°C. However, having left the tank and passed into the enclosed fuel supply system, the temperature may be raised for a short period to 200°C without significant deterioration. In the case of Mach 3 aircraft, either conventional fuels must not be allowed to exceed the foregoing temperatures, or a new fuel must be developed having suitable properties.

At M=2+ an appropriate air-conditioning system can be obtained using tapped engine compressor air. Cooling is achieved by successive heat exchange with boundary layer air, fuel flow and vapour-cycle refrigerants. The main development is confined to refining cabin insulations and in the high temperature condensing vapour-cycle refrigeration components.

Again, at M=3, with the higher surface and stagnation temperature, the cooling requirement is considerably greater.

Maximum allowable temperatures for low inflammable hydraulic fluids may be limited to 220-240°C. At the higher speed individual components will be exposed to much hotter conditions and it is likely that, after including energy losses, the bulk fluid could rise to as high as 450°C. This would involve considerable developments of an unpredictable nature.

A comparison of system weights showed that, taken together, the fuel, flying controls, hydraulics, electrics, electronics, radio and air conditioning amount to 16% of the manufacturer's weight empty for a Mach 2.2 aircraft, and 12-13% for a subsonic jet transport. For a constant payload, the weight of the combined systems on a Mach 3 project was 15% higher than for Mach 2.2, but the estimated empty weight also increased to keep the proportion the same (16%).

For ranges of more than 1,500 miles, the Mach 2.2 aircraft has lower aircraft mile costs than either the subsonic or the Mach 3 type. On the basis of seat-mile costs, the supersonic aircraft appears to be about 20% higher than the best subsonic.

There can be little argument that if subsonic and supersonic aircraft were in direct competition at equal fares, the actual load factors would show great disparity. The question to be asked is, what surcharge would balance the competition? The overall economics at a load factor of 60% would be equal if the fare differential were about 8%—say a halfpenny per mile. This is equivalent to about £2 per hour of travelling time saved.

Similar considerations are applicable to competition between the two classes of supersonic aircraft. These percentages are equivalent to about £4 and £16 per hour of travelling time saved.

The Influence of Some Operational Problems in Supersonic Air Transport

The aircraft industry is now moving from the preliminary assessment to a more practical stage in the development of supersonic transport aircraft and will need to define with more precision the operational restrictions likely to be met in regular airline service. R. G. THORNE, *of the Royal Aircraft Establishment, discusses some of the many problems which have emerged during the past five years.*

Overall the impression given by this paper is that the SST—and particularly that designed for Mach 3-plus operations—poses some very difficult questions, none of which are, however, incapable of solution within present knowledge. The conclusions reached in the paper were these:

A rigorous attack should be made on the delineation of the many operational factors which influence the relationship between the formula cost per seat-mile and the revenue over a network of routes.

A rational method for estimating the fuel reserves, allowing for the effects of new control and navigational equipment, is essential if the implications of operational restrictions are to be established on a firm basis.

International agreement on subjective limits for the noise around airports and under the cruising flight path is urgently required. Until this is effected, the aircraft designer cannot

reasonably be expected to produce detailed economic assessments of the supersonic transport's feasibility over World-wide airline networks.

Improvements in the standards of passenger comfort achieved on current aircraft are essential if air travel is to maintain its present rate of expansion. In the past the aircraft systems have been squeezed into configurations designed to give a good compromise between the aerodynamic, structural and propulsion restrictions. In the future the systems engineer must play a larger part in the definition of the basic characteristics.

It would be unfair to suggest that the success of a supersonic transport will depend entirely on how it is operated. The basic aircraft design team will have more than their fair share of headaches. A number of these will depend on the increased sensitivity of the supersonic aircraft to small changes in the basic design characteristics.

In transatlantic operations 10% change in the cruising lift-drag ratio will give roughly 8% change in the direct costs of a Mach 0.85 aircraft and 20% change in the costs of a Mach 2-plus aircraft. This in an indication of the prize to be won by continued refinements to the basic aerodynamic, structural and propulsion characteristics. The penalties of failure are somewhat greater. Continued refinement of the basic design will, of course, make it easier for the designer to cope with difficult operational restrictions without incurring undue economic penalties.

At the start of his paper Mr. Thorne made some pertinent comments on the subject of economics:

Since existing methods permit the prediction of direct operating costs at an early stage in the design of a civil aircraft, project engineers indulge in "parametric studies" to seek "optimum" combinations of those parameters which particularly influence the operating economics.

One can pretend to be too clever in this approach. The direct operating cost at full load is only about one-third the fare paid by the passenger. The remainder depends on the ability of the operator to fit the vehicle into reasonable schedules, to attract passengers in off-peak periods and to streamline his overhead costs.

Later the author suggested that, with modern digital computing facilities, the arithmetic involved in "optimization" studies need not be prohibitive and that the main problem concerned the establishment of the basic traffic and operational information required for the study.

Dealing with A.T.C. and airport restrictions, the paper suggested that the SST would, broadly, be twice as sensitive to operating restrictions such as holding at altitude limitations when compared with the subsonic jet if the extra fuel required can be met from reserves. If the extra fuel has to be found by off-loading payload then the SST could be about four times as sensitive.

It was suggested that the typical M=2-plus aircraft would make its transition in level flight at about 40,000 ft. followed by a supersonic climb at about 2,500 ft./min. At about 50,000 ft. it would settle into a constant Mach climb and it would start the true cruise-climb at an altitude of 55,000 ft. when about 400 miles out, eventually reaching 65,000 ft. The time from take-off to start of cruise would be 20-25 min.—or about the same as that for a subsonic jet, though covering three times the distance. Descent would start about 200 miles from destination and the time to landing would be 25 min.

TAKE-OFF AND INITIAL CLIMB COMPARISONS

	Subsonic aircraft M=0.85	Supersonic aircraft M=2.2
Wing loading (lb./sq. ft.)	105	65
Static thrust/weight ratio	0.24	0.41
Mean acceleration—ground run (ft./sec²)	6	9
Thrust/weight ratio at climb away speed	0.21	0.38
Initial gradients of climb:		
(i) Maximum thrust	0.135	0.13
(ii) One engine out	0.085	0.07
(iii) Noise abatement procedure	0.035	0.035
Initial rates of climb (ft./min.):		
(i) Maximum thrust	2,300	2,500
(ii) One engine out	1,400	1,300
(iii) Noise abatement procedure	600	700
Rotation speed (knots)	156	185
Initial climb away speed (knots)	174	195
Distance to 35 ft. +20% ISA+10°C (ft.)	9,600	8,500

APPROACH AND LANDING COMPARISONS

	Subsonic aircraft M=0.85	Supersonic aircraft M=2.2
Wing loading (lb./sq. ft.)	65	40
Threshold speed (knots)	140	140
Threshold C_L	0.98	0.6
Threshold angle of attack°	2	13
Threshold fuselage attitude to ground°	−1	10
Touch-down speed (knots)	120	135
Landing field length ISA+10°C (ft.)	8,500	7,500

Mr. R. G. Thorne's paper

The high thrust-weight ratios required for supersonic flight will permit sophisticated throttled climb procedures to be employed which will reduce the noise level outside the airport boundary. A typical supersonic aircraft should be about 3 PNdB noisier on ground roll and 4 PNdB quieter on throttled climb path than a typical subsonic aircraft. The use of long intake ducts for supersonic engines will offer scope for the reduction of compressor noise—which, with subsonic aircraft, causes the greater annoyance on approach.

In the past the systems designer has had at his disposal a large source of heat (the engine compressors) and an infinite heat sink (the atmosphere). In designing a supersonic aircraft, however, the heat sink must be carried in the aircraft and any error in assessing the size of this heat sink will result in a penalty.

For flight times in excess of two hours a vapour-cycle refrigeration system is more attractive than an air-cycle system. Vapour-cycle refrigerants require heat-sink temperatures not greater than about 70° C. for efficient operation. The most satisfactory heat sink will be the aircraft fuel—but this will involve fuel-tank insulation or the use of precooled fuel. For flight speeds above M=3 consideration may have to be given to closed-circuit conditioning systems. Humidification systems may not be required when flight times are short. Filtration may be necessary to deal with ozone concentration and regular travellers on M=3 aircraft (reaching 75,000 ft. at the end of cruise) may have to be subjected to routine medical checks for cumulative cosmic radiation effects.

Transports of the Future—A Systems Approach

The authors, GEORGE C. PRILL and HAROLD HOEKSTRA, of the F.A.A., suggest that the traditional concept of "airworthiness" be broadened into a new concept of "systemworthiness." The supersonic transport must be systemworthy and so must every other component of the system, if success is to be attained. The paper outlines the status of the major elements in the U.S. aviation system, estimates the future trends of these elements and indicates how these trends may affect the development of the SST.

Under the heading of safety, the authors show that accidents to U.S. air-carrier aircraft (including training and non-revenue, both fatal and non-fatal) follow an approximate 60% learning curve. Improvements in "crashworthiness" are called for, involving not only aircraft design but also fire-fighting and emergency equipment at airports. A high proportion of all landing accidents are of the "planned abnormal" type; there may be much to be gained by designating on a systems basis a network of airports specially equipped to handle such planned emergency landings.

To maintain or improve reliability, automatic checkout and greatly improved maintenance techniques must be developed as part of the SST system. Special attention must be paid to avoiding faults which demand non-routine repairs.

It should be assumed that by the 'seventies the supersonic transport system will carry economy-class passengers almost exclusively, with a special set of seats forward for motion picture stars (*sic*).

Passengers want low-cost transportation and will ride inferior equipment in terms of passenger service and trip time to get it. When this "inferior" equipment is the Super VC10, will many pay a stiff differential to ride supersonic aircraft? The authors doubt it. Therefore, the designers of the supersonic transport system must aim for an airline revenue per passenger-mile of about 6¼ cents or a real revenue of 3.9 U.S. cents per passenger-mile expressed in 1946 dollars. This is a hard goal.

The expected high thrust-to-weight ratio of the supersonic transport should assist in maintaining adequate acceleration and take-off performance. However, every effort must be devoted to holding the touch-down speed close to the value of present jets. Otherwise, the landing field size may dictate the landing weight for many operations. It should not be expected that runways will be lengthened for the supersonic aircraft, as there will not be a sufficient percentage of movements from the average airport to justify this.

Advances in all of the aspects of airports must continue and the supersonic transport designers must be alert to the need to incorporate provisions to accommodate these advances in the coming aircraft. Likewise, much work must be done to make the airports systemworthy. Standard lighting and electronic approach aids must be installed and much more attention must be given to the overrun problem. If arresting means are to be used, they must be internationally standardized.

It must be realized that the percentage of supersonic transport movements to total movements will always be small and that the system cannot give unreasonable priority to the supersonic transport. Special navigation facilities for high-altitude control may be necessary but it is hoped not. The aeroplane should

R.Ae.S.—I.A.S.—C.A.I. Symposium

fit into the super-high-altitude area control phase of the system using on-board navigation aids with check points as required. A radar/computer system on the ground will follow the flight when over land. On the over-water legs inertial navigation or Doppler radar equipment should permit better position fixing than is now possible.

For supersonic transport operations at cruise altitudes, the most practicable navigation system appears to be the self-contained Doppler or inertial system, perhaps supplemented by super VOR/DMEs. A super VOR/DME would be frequency-protected to ensure interference-free service at greater distances and to higher altitudes.

The designers of the supersonic transport must keep abreast of developments in collision avoidance systems so that provisions may be incorporated to permit use of the best devices available in the aircraft.

The use of a C.A.S. does not mean that positive control will not be necessary but rather that with a satisfactory collision warning device the present, rather enormous, separation standard could be reduced.

In the supersonic transport the altitude of acceleration to supersonic speed is highly important from the standpoint of performance; obviously the lower the better for minimum block time and fuel consumption. Further, it will present a problem in traffic separation since there is a time premium on both the minimum altitude consistent with sonic boom limitations and the straightest track. This phase will dictate substantial improvements in altimeter reliability over systems presently in use. Inertial sensing may be of particular value in this phase of flight.

Numerous advances in flight testing state-of-the-art must be achieved before the programme can even be conducted. Considerations related to the possible public nuisance and hazard aspects of the programme must be pondered and treated with prudent action. These include such matters as a possible requirement to conduct much of the flight test programme over water. If this were required, a new era of seaborne or airborne telemetry receiving station coverage might come into being. The mere timing of the aircraft to pass within range of the telemetry ground station at proper atmospheric conditions, a stabilized structural temperature and at the planned Mach number and load conditions may present an appreciable problem.

International co-operation will be mandatory for successful introduction of the supersonic transport. London/New York must be as simple a route in terms of facilities, communications, and so on, as Los Angeles/New York.

The next 10 years will be fraught with interest.

The Inverted Turbojet

A thermodynamic analysis, by D. L. MORDELL, F. W. EYRE, *and* A. V. SREENATH *from McGill University, of a power-plant for hypersonic speed—in which the usual sequence of components is changed to: intake, turbine, heat exchanger, compressor, combustion chamber and nozzle. Its development problem and possible applications are discussed.*

"The inverted engine may be considered as being somewhat analogous to the reheated turbojet, which might be regarded as a ramjet, in which is interposed between the intake and the main burner, a turbine system which adds heat by combustion to raise the pressure and temperature of the intake air. In the inverted turbojet, we have interposed between intake and main burner, a turbine system, operating on the temperature difference between the intake air and a cold sink, which raises the pressure but lowers the temperature of the air before reaching the main burner. . . ."

"Clearly such an engine is unlikely to compare favourably with a pure ramjet in the range from Mach 3 to Mach 6, nor favourably with a turbojet in the range Mach 0 to Mach 3, but the fact that it can conceivably operate over the whole range entitles it to some preliminary consideration. . . ."

"The ultimate fuel in this type of engine, of course, is liquid hydrogen. . . . The performance figures obtained are of the same order of magnitude as those which would be expected with ramjets, but in the case of the inverted turbojet, there is a rotating shaft which means that it is easy to tap off power for fuel pumps and aircraft accessories, and a relatively large amount for refrigeration (at the expense of thrust, of course). . . ."

"It is clear from these preliminary project studies that this type of engine is going to be a relatively poor performer at speeds below a Mach number of 2, and indeed cannot compare with the turbojet engine at such speeds. The main point is that it can be run for the purpose of checking systems and might supply some of the take-off thrust if necessary. It might also be able to provide enough thrust for control during a landing manœuvre."

Talking Points on V/STOL Techniques

Lectures devoted to the low-speed end of the operating scale ranged over many aspects of the problem of obtaining vertical or very short take-off and landing distances. Below are quoted some of the many noteworthy points made in these papers.

Ground Proximity Effects Associated with V/STOL Aircraft

In this paper, JOHN P. CAMPBELL, *from NASA Langley Research Center, discusses various problems arising from operation of* V/STOL *aircraft close to the ground. All forms of ground proximity effect are covered—including effects of slipstream impingement and recirculation on the surface beneath the aircraft, on objects around the take-off and landing area, and on the aircraft itself.*

"The ground effect at low forward speeds may be of special significance for propeller V/STOL aircraft of the tilt-wing-and-flap type because superior STOL capability is usually cited as one of the basic advantages of such aircraft. . . ."

"Experience with VTOL research aircraft having two laterally disposed propulsive units—that is, a rotor, propeller, or ducted fan on each wing—has shown that erratic flight characteristics about one or more axes are usually obtained when the machines are hovering within about 10 or 15 ft. of the ground; and the ground effects tend to become more severe at low forward speeds when the aircraft fly into the disturbances created by their recirculating slipstreams. . . ."

"Although research has indicated some pertinent factors involved in the problems of surface erosion and recirculation of debris, experience with higher-performance V/STOL aircraft under actual operating conditions is required to determine to what extent the utility of the aircraft will be compromised by these problems. . . ."

"Research so far has also indicated that slipstream recirculation can have pronounced detrimental effects on the handling qualities of V/STOL aircraft flying near the ground, and further research appears to be needed to minimize these effects. . . ."

Some Considerations in Selecting VTOL Propulsion Systems

A review by A. P. ADAMSON *and* D. COCHRAN, *from the General Electric Company's Flight Propulsion Laboratory Department, of the engine characteristics which must be considered in selecting the best engine for a* VTOL *aeroplane. In this paper, most attention is devoted to jet-lift, turbofan-lift, and tip turbine fan-lift engines suitable for high-speed aeroplanes. A second part of this paper presents test data from the General Electric/U.S.A.F./U.S. Army/NASA lift fan and diverter valve research programme.*

"For commercial use, the propeller and the lift fan are the likely candidates, since with the turbofan engine or the jet engine the V-Port required for noise control would be so large that a STOL aeroplane with better operating costs could be used.

"Exhaust temperature level is important for military transport, liaison, reconnaissance, and fighter aircraft which must operate with the forward-area troops, but is less critical for commercial transport aircraft or for military aircraft operating from prepared sites. . . ."

"It has been observed that the recirculation tendency with ducted devices may be lessened due to the absence of tip vortices and lack of the radial inflow field at the propeller blade tip. This factor should alleviate the low-altitude visibility-loss problem experienced by helicopters. . . ."

"The high fuel consumption of the turbojet engine tends to limit its uses to missions with very short lift-mode operating

times. Lift-mode operating time may be 5 to 10 minutes for forward-area military aeroplanes and for transport aeroplanes, particularly if at least two take-offs and landings per mission are required, as will often be the case. Short operating time, perhaps as low as one minute, may be characteristic of aeroplanes used in highly instrumented, automatically controlled, sophisticated weapons systems. . . ."

"Efficient design usually dictates that the cruise engine thrust be used at take-off by tilting the engine or by means of a diverter valve, since the thrust-to-weight ratio of the diverter valve considered alone is 30 : 50. Additional lift beyond that developed by the cruise engine must then be provided. . . ."

"Generally, the added lift should be provided by special lifting equipment rather than by oversizing the cruise engine—since in most missions the cruise engine performance, cost and weight will be badly compromised by the substantial oversizing required. . . ."

"The use of many small engines in an aeroplane, along with the accompanying control and fuel-system redundancy or duplication needed to retain true multiple engine reliability throughout the system, is a joy to contemplate for an engine maker—but our joy is not universally shared. . . ."

"Overall aeroplane and engine aerodynamic performance indicates that little difficulty should be encountered in adapting 'conventional' aeroplane aerodynamic configurations to VTOL use with lift fans installed in the wing or fuselage. . . ."

"VTOL propulsion progress on lift fans, direct-lift engines and turbofans has been rapid, so the airframe designer can now confidently proceed with VTOL aircraft designs and select the proper powerplant for his requirement. Integration of engines and airframes will require unusually close work between the engine and airframe companies."

Aerodynamic and Propulsion Considerations of Minimum-field Aircraft

P. L. SUTCLIFFE and V. K. MERRICK, of Hawker Siddeley Aviation, Ltd., and A. R. HOWELL, of the National Gas Turbine Establishment, discuss the broad aerodynamic and propulsion aspects of flight at the very low speeds necessary for performances within the meaning of "minimum field."

"In the authors' opinion, the definition of STOL should be independent of the class of aircraft and should merely define the take-off distance to 50 ft. and the landing distance from 50 ft. But it is not enough merely to say that STOL means 500 ft. and an aircraft that requires 600 ft. is not STOL.

"Clearly there must be grades of STOL and in the interests of clearing the air on this point the following standards are proposed:—

Airfield performance	Definition	Abbreviation
Zero take-off and landing distance	Vertical	VTOL
Less than 500 ft. to and from 50 ft.	Ultra-short	USTOL 'minimum-field aircraft'
Between 500 ft. and 1,000 ft.	Short	STOL 'minimum-field aircraft'
Between 1,000 ft. and 2,000 ft.	Intermediate	ITOL 'minimum-field aircraft'
Greater than 2,000 ft.	Normal	NTOL

"When using a consistent set of safety rules applicable to undeflected and deflected thrust configuration and including VTOL designs, whereas ITOL performance is feasible with conventional undeflected thrust systems, it is unlikely that better airfield performance could be achieved except at either very low wing loadings or high thrust/weight ratios, or both.

"If the propulsive thrust is deflected, then the whole picture changes considerably. With only modest thrust/weight ratios of, say, 0.4 it appears to be possible to obtain STOL performance at low wing loading (30 lb./sq. ft.). With a thrust/weight ratio of 0.6, i.e., typical subsonic fighter level, STOL capability is possible at wing loadings up to 70 lb./sq. ft. if the aspect ratio is 5 or more. . . ."

"When considering minimum-field aircraft it always pays to deflect whatever thrust is installed. . . ."

"First choose the most efficient propulsive system for the normal airborne part of the flight plan and deflect it for take-off and landing. If the resulting airfield performance is not as good as required, then make up the additional thrust by lightweight lift engines. . . ."

"For VTOL and USTOL the thrusts and lifts are comparable to, or greater than, the all-up weight of the aircraft. The most promising configurations for the specialized lightweight lift engines are considered to be turbojets, integral fan engines with front or rear fans, and remote fans with hot-gas tip-turbine drives. . . ."

"For STOL and ITOL duties with turbofans, the by-pass air or part thereof could go direct to a jet flap, or high-pressure compressor air bleed could be used with blown flaps. . . ."

"Because of the great strides made in the development of lightweight engine components, there is promise for the future of specialized turbojets and turbofans having basic specific weights of only 0.06 to 0.07 lb./lb. thrust or lift.

"Unfortunately [these] achievements are to some extent nullified by installation penalties and by increased lifts and thrusts for control, engine failure, and hot and high operation. Installation penalties can add 50-100% on to the basic engine weights. . . ."

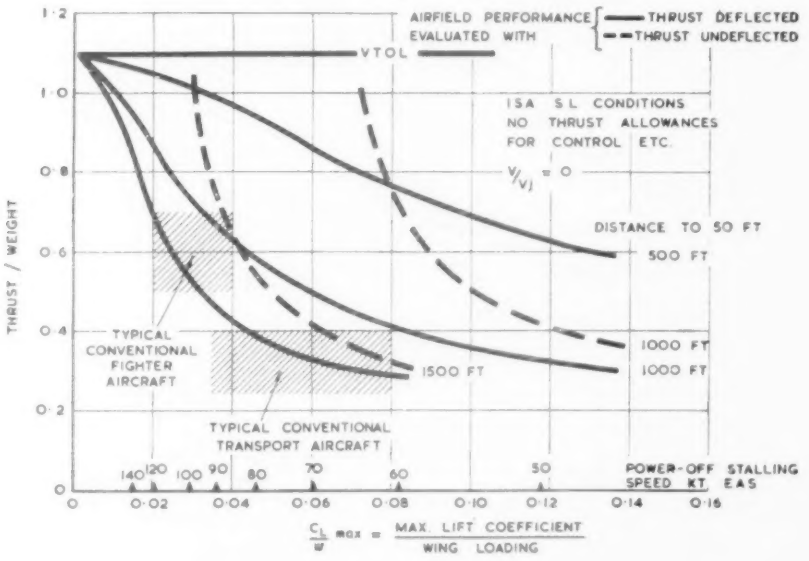
"Although for most military and commercial uses it is thought that the future of minimum-field aircraft lies with the various applications of turbofans and turbojets, at present they are not silent enough for city-centre operation. . . ."

On the Nature of Aerofoil Characteristics with a Sink Located in the Upper Surface—including Comparison with Some Fan-in-wing Experiments

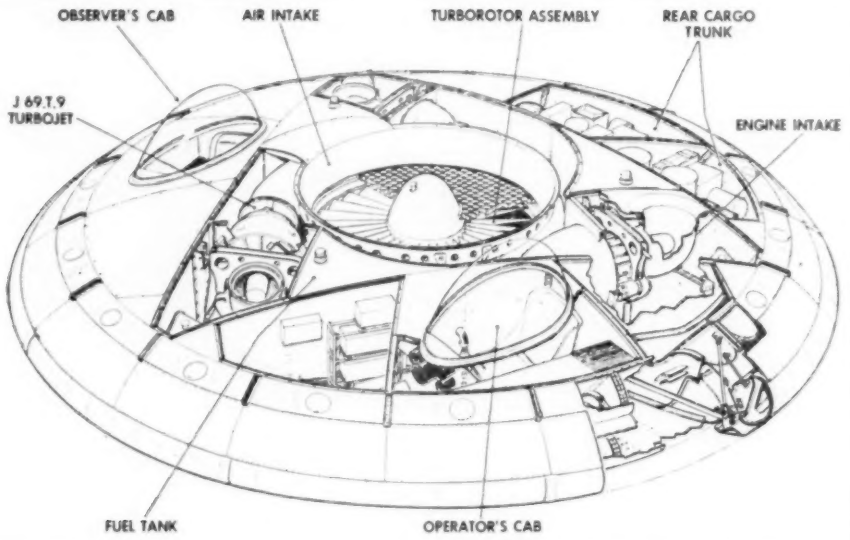
A description by D. C. WHITTLEY and J. R. BISSELL, of Avro Aircraft, Ltd., of theoretical and experimental analyses of the nature of the problem of large nose-up moment associated with the fan/wing combination in powered-lift systems in which airflow enters through the upper wing surface. Particular reference is made to the Avrocar.

"In recent years there has been considerable interest shown in powered-lift systems for aircraft which are designed to give either STOL or VTOL capability. The jet-flap scheme, in which a jet issues from the trailing-edge of the wing, is perhaps the prime example for application to STOL. . . ."

"More recently, consideration has been given to systems in



The influence of deflected thrust on the airfield performance of various types of aircraft. (From the paper by P. L. Sutcliffe, V. K. Merrick and A. R. Howell.)



This cut-away drawing in the paper by D. C. Whittley and J. R. Bissell shows the general layout of the remarkable Avrocar.

which airflow enters through the upper surface of the wing and is discharged at the trailing-edge or, more commonly, through deflector vanes beneath the wing itself—as, for example, in the case of VTOL fan-in-wing designs. . . ."

"This paper deals primarily with the effect on aerofoil characteristics of flow into the upper surface. A potential flow solution is derived for a two-dimensional flat-plate aerofoil and a method is suggested for analysis of fan-in-wing experiments which permits the nose-up moment to be isolated so that comparison can be made with theory. . . ."

"This approach to the problem assumes that simple laws of flow super-position do apply, which is probably an acceptable assumption at the present stage of investigation. . . ."

"The fan-in-wing configuration represents a fairly complicated aerodynamic form and the influence of inlet flow alone cannot be inferred directly from existing test results because it is not usual to have an inlet flow without a corresponding jet flow. . . ."

Looking Ahead in V/STOL

A review by GEORGE S. SCHAIRER, *of the Boeing Company, of the fundamentals of very low speed and transition flight; characteristics to be expected from wings, jets, propellers, etc., alone and in combination, are examined. A similar review is made of propulsion systems for* V/STOL *aircraft in high-speed flight and the overall performance of* VTOL *vehicles is also examined. Fundamental differences between* VTOL *and* STOL *are discussed.*

"The helicopter appears to have no serious competition in those applications where silence is required or where long hovering is required. Where the distance to be flown is short, speed will usually be unimportant and the helicopter is likely to remain supreme. . . ."

"By a drag clean-up and by proper blade aerofoil choice, and by boundary-layer control, helicopters can be built with speeds above 200 knots.

"Tilt-wing or tilt-propeller types are likely to have attractive range-payload-hovering performance. For those circumstances where the increased velocity of the downwash does not rule them out, and where the increased noise over that of the helicopter is acceptable, the tilt-wing or tilt-propeller types can demonstrate excellent range-payload-speed performance. . . ."

"Jet- and fan-lift aircraft appear to offer good range-speed-payload performance where substantial range is required and where hovering requirements are at a minimum. Where these aircraft are subsonic, it is likely that the lift engines and the propulsion engines will be of the turbofan type. . . ."

"Small-diameter shrouded propellers are frequently proposed as a means for getting adequate vertical take-off thrust. Such devices require a lot of power and hence potentially provide for high speeds, but also provide for relatively high hovering fuel consumption. It is likely that any such arrangement can be bettered by removing the shroud ring and installing a slightly larger propeller. . . ."

"Tandem tilting arrangements require additional study. Tandem arrangements with two rotors forward and two aft are attractive from a control standpoint. Such arrangements, when provided with a wing of adequate span, will have performance comparable to tilt-wings. . . ."

"Of special interest in the short take-off and landing discussion is the question of blown flaps. It is entirely possible that flaps with extensive blowing will be very attractive for the STOL mode of operation. Further testing of blown flap arrangements is urgently needed to clarify their characteristics. . . ."

"Stalling is a major consideration in the design of V/STOL aircraft and is likely to be the central theme of the aerodynamic design. Ground effects and their influence on stalling are likely to be exceedingly important. . . ."

"The technology of vertical-lift aircraft is reasonably well developed in the case of the helicopter, but hardly explored for other arrangements. . . ."

Control of VTOL Aircraft

J. J. FOODY, *of Short Brothers and Harland, Ltd., discusses the principles involved in the control of* VTOL *aircraft in the transition speed range, i.e., below the speed at which airborne flight can be sustained. He outlines the philosophy behind the "multiple lane" approach employed by Shorts and describes the SC.1 control system.*

"It is obvious from the stability characteristics displayed by VTOL aircraft, from neutral stability in the hovering configuration to negatively damped lateral oscillations at higher speeds, that the normal stability criteria levelled at military and civil aircraft are not met. Whether such criteria are completely applicable is arguable, but there is at very least a case for stabilization, except where military requirements may involve acceptance of a difficult control task. . . ."

"In the general case, especially with multiple-engined VTOL aircraft, limited authority systems leave much to be desired in hover, and may prove an embarrassment during a transition where large changes in moment occur due to various aerodynamic effects. The alternative is a multiplexed control system, the simplest form being that in which there are two lanes for each channel of control. . . ."

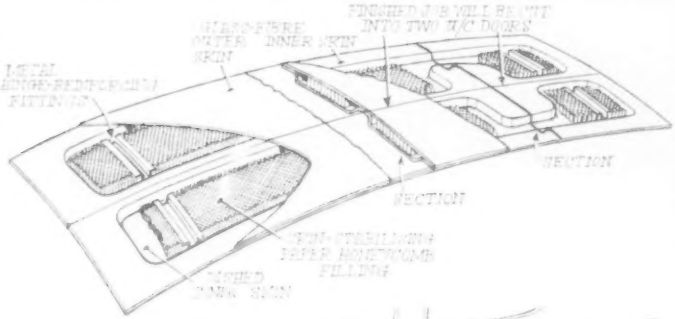
"There is now no doubt that VTOL aircraft, with automatic damping about two axes and with no other form of pilot assistance, can be controlled in a decelerating transition. But what is not yet adequately determined is the efficiency and accuracy of this manœuvre and the optimum technique to ensure both controllability and economy in the manœuvre. Neither is it clear that such a manœuvre is possible under poor conditions of visibility as normally associated with the all-weather requirement. . . ."

"In the automatic landing of conventional aircraft, it is considered that pilot intervention, other than to initiate overshoot, is impossible; hence no special instrumentation is used. On a VTOL aircraft, however, in the event of certain malfunctioning, it would not appear to be beyond the capability of the pilot to make an instrument approach and landing if he is provided with suitable instruments. . . ."

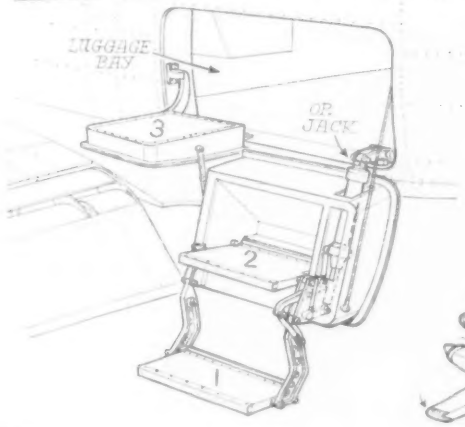
"Few unsolved technical problems now stand in the way of an operational aircraft, but while some of the automatic control problems may be soluble, their solution will unquestionably take time, and this time is of the same order as, if not longer than, that involved in the design of the aircraft itself. . . ."

BEAGLE 206 DETAILS

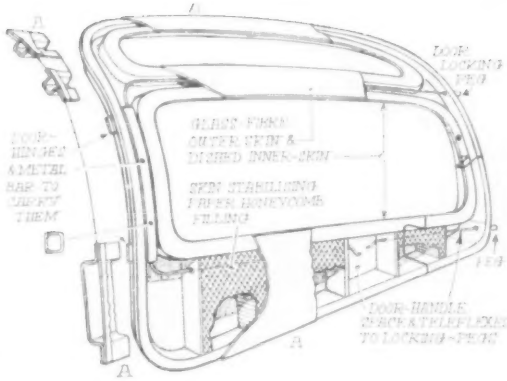
These drawings by J. H. CLARK, A.R.AE.S., *illustrate some of the structural features of the Beagle-Masefield B206 executive aircraft which has been a centre of so much attraction since its first public appearance just before the S.B.A.C. Show. The aircraft was described in detail in our issue for August 24.*



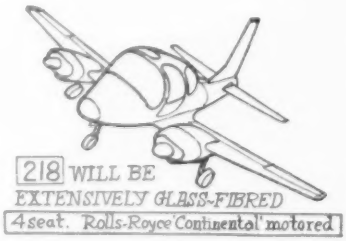
Above, undercarriage door construction.

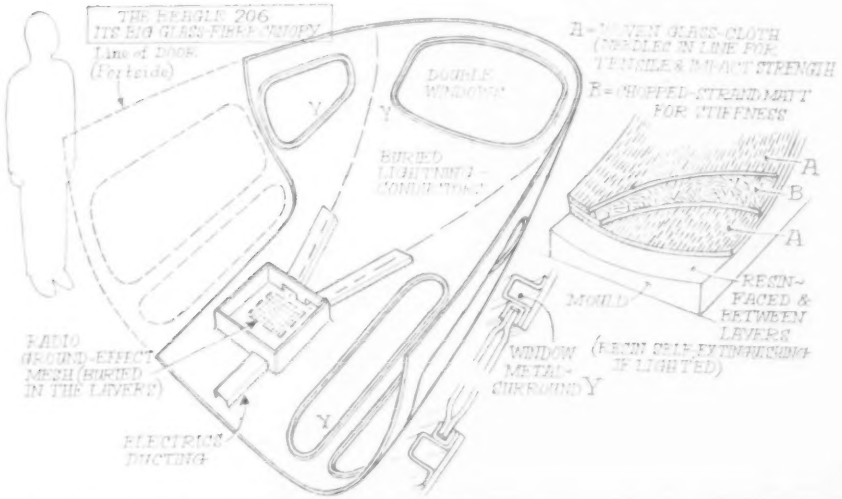


Left, the neat folding steps in the luggage bay hatch.



Left, the door structure.





Left, details of the cabin canopy.

© Temple Press Limited, 1961

Airborne AC Generating Systems

A RECENT addition to the aviation engineering facilities of The Plessey Co., Ltd., is the new laboratory for its Aircraft Electrical Division at Ilford. Situated on Eastern Avenue, Romford, this laboratory has been specifically designed for the development and multiple testing of AC generating systems.

Its construction is a direct result of a detailed study by the Division into the requirements for producing this type of airborne generating equipment. Building started in June, 1960, and the first members of the engineering team were transferred from Ilford in March. By the end of this year the first stage of the move of equipment and personnel is scheduled to be completed.

A single-storey self-contained building, it has been laid out for the design, development, assembly and testing of both generating systems and components. The majority of the actual components involved are produced by other companies within the Plessey group.

Design and development facilities at Romford comprise laboratory space, a workshop area, drawing and engineering offices, and a high-voltage room.

There are also four bays for the development testing of up to four generator systems. One bay has a constant-speed generator drive powered by an electric motor and capable of developing 300 h.p. The other three have variable speed drives of 200 h.p., with controlled acceleration up to 1,200 r.p.m./sec. The speed range of the variable drive is 2,400 to 12,500 r.p.m. Three-phase loading, both resistive and reactive, is variable between zero and 120 kVA. per channel.

Heating and cooling facilities enable the ambient bay temperatures to be controlled. In addition, high-speed ram-air cooling of the equipment under test can be simulated at up to 300 cu. ft./min. flow at 22 in. w.g.; and it will also be possible to raise bay temperature to 100° C. as required.

For production testing, the same generator drives are employed together with point-to-point fault location consoles for checking the generator control equipment. These test consoles can be programmed by punched tape for automatic continuity and wiring verification on any type of control or ancillary unit. A hot and cold chamber enables components to be checked over an environmental temperature range from −60° C. to +120° C.

Present and Future Installations

Plessey are currently manufacturing two basic types of AC generating equipment under licence from Westinghouse Electric International Co., of the United States, and Précision Mécanique Labinal of France. Labamatic generators and associated control equipment have been in production at Ilford for the past two or three years and the first Plessey-manufactured Westinghouse components have now been completed as part of the production programme.

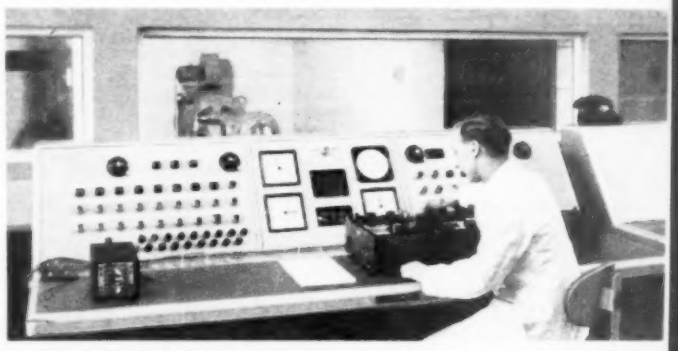
The initial Westinghouse installation to be produced at Eastern Avenue is the generating system for the Vickers VC10. Future projects include the testing of similar systems for the B.A.C. One-Eleven. The first complete VC10 system is planned to be supplied to Vickers in mid-1962, and when the company receives the contract for the One-Eleven system the production programmes of the two installations will overlap.

For the VC10 the generating system has been completely designed, developed and tested by Westinghouse, and Plessey are setting out to prove that components produced in this country are completely interchangeable with U.S. equipment. The One-Eleven system on the other hand will be a Plessey design using Westinghouse components manufactured under licence.

A four-generator installation with a total power output of 160 kVA., the VC10 system is capable of handling four paralleled channels of equipment up to 40 kVA. normal load per channel. Split into two sections with Nos. 1 and 3 40-kVA. AC engine-driven generators supplying one half and Nos. 2 and 4 generators the other, the system's available capacity can be shared over all essential user equipment should loss of power on one or more channels occur. Sundstrand drives are employed between the engines and the generators but Plessey constant-speed units will be used in the One-Eleven.

Plessey are planning to incorporate the Westinghouse 100-hr. cycle testing programme of the various sections making up the complete system in order to eliminate major component failure in the first 100-hr. of operation caused by maladjustment of faulty units. This test comprises 2 min. of fault finding followed by 28 min. of normal load running which is repeated every 30 min. The last 30 hr. of test running must be fault free.

The Westinghouse system is guaranteed for 3,000-hr. trouble-free operation and its overhaul life expiry is given as 5,000 hr.



Top, a technician oversees a series of tests on a 40-kVA. system at the new Plessey generating systems laboratory at Eastern Avenue West, Romford (left). Above can be seen a section of the spacious laboratory area.

Battle of Britain Display Flying

DESPITE the varying weather conditions experienced over the British Isles last Saturday, flying at the 16 Battle of Britain displays open to the public went on very much as planned. Those worst affected were in the west of the country where the full force of the gales whipped up as a legacy from the Atlantic hurricane "Debbie" was felt most.

Although fewer stations were open this year, attendance was well up—totalling 906,500 according to provisional estimates by the Air Ministry. This compares with 766,500 last year when 25 stations were open. As always, Biggin Hill headed the list with a 180,000-strong crowd, and two other stations, Finningley and Middleton St. George, topped the 100,000 mark.

Bulk of the flying at these displays is undertaken by a number of "circuses" of touring aircraft drawn from the R.A.F.'s operational Commands. This year, to get some idea of what is required of participants by way of precision timing, we were privileged to travel in a Britannia which visited seven of the displays.

This aircraft, serialled XN404 and named "Canopus," is one of 23 Britannias operated on a pool basis at Lyneham by two squadrons, Nos. 99 and 511. Twenty of the aircraft are of the 253 type, having been built specifically for Transport Command by Short Brothers and Harland. The other three, of which the tour aircraft was one, are 252s, having been ordered originally by the M.o.A. and subsequently transferred to the R.A.F.; they have interiors fitted out to airline standards and are used mainly for V.I.P. work.

Take-off from Lyneham was at 14.06 hrs. with XN404 having a crew from 99 Squadron with the C.O., Wg. Cdr. W. E. F. Gray, as captain. As laid down in the voluminous operations order prepared by Fighter Command—the "bible" for display circus flying—our A.T.D. should have been 14.26 hrs.

After five minutes en route it became evident, as indeed one might have expected, that the navigator was the key man to the whole operation. Precision timing is needed in any form of display flying, and circus touring is no exception.

At each of the stations to be visited three minutes were allotted to the Britannia for a pass. Should the timing of the stage-length between any of the airfields be miscalculated, resulting in early or late arrival, then the whole display sequence is thrown out of gear and immediate replanning is necessary. Only once during our tour were we to experience this—arriving 30 sec. late at Colerne. Here the Britannia was only allowed to make its run to the north of the airfield because a Canberra was running in on a reciprocal heading on time.

Flying contact with the ground for long periods is something of a novelty for crews normally employed on long-range operations and map reading from a large-scale chart is very rare indeed. From the navigator's continuous perambulations on the crowded flight deck one could appreciate his efforts in getting the aeroplane in the right place at the right time. To achieve this, continuous consultations with the captain resulted in the constant readjustment of the airspeed. Main cause of the trouble were the strong winds which varied from 20 kt. to 60 kt., giving rise to much buffeting and the recording of up to 1.5 g.

Kemble was reached 8 sec. behind schedule but this time was soon made up and Moreton-in-the-Marsh passed below the starboard wing on time, 14.36. Gaydon, our first display of the day, was called one minute later.

Clearance for the run-in was given with the warning that a Spitfire was on short finals. Right on time our Britannia passed down Gaydon's "zero-six" runway. A second run-in was abandoned because the controller had a Lightning coming in short of fuel.

When demonstrating the Britannia, Service pilots have developed a technique which places emphasis on this aircraft's popular nickname, "The Whispering Giant." Some five miles from the runway threshold the throttles are opened to build up the airspeed to 250 kt. On crossing the threshold at between 300 and 500 ft. the captain orders "Flight Idle," whence the throttles are closed down and the aircraft coasts past the spectators with the minimum of noise.

From then on the tour followed similar lines to the procedure already described. From Gaydon there came a left turn out for the leg to St. Athan. This was almost parallel with the mouth of the River Severn. Evesham was passed at 14.48; ten minutes later the meanderings of the Wye near Monmouth came into view and at 15.03 Newport, crowned with a black industrial haze, was beneath the port wing. As the run to St. Athan progressed, visibility decreased and wind strength increased.

The run-in here was made from over the now derelict airfield of Llandow, once a flourishing M.U. The snaking taxi-track which connected it with St. Athan was still visible. A second pass was requested and duly complied with and a time check revealed that we had slipped two minutes behind schedule.

Chivenor was the next port of call. The crossing of the foam-flecked Bristol Channel was made in poor visibility and steady rain. Our two lost minutes were made up by a fortunate lull in the flying there and we were able to run in via Ilfracombe.

One pass at Chivenor was made down runway "one-zero" climbing back to 2,500 ft. over Barnstable for the 16½-min. run to Wells. Moving eastward now the visibility quickly improved and the cloud base lifted. By the time Colerne was reached a watery sunlight was filtering in through the narrow flight deck windows. As already mentioned, because of late arrival at Colerne, our pass was higher and less spectacular than those made previously—the penalty for lateness.

Our home base, Lyneham, was overflown at 15.51 hrs. and five minutes later Abingdon came into view, the box-like Beverleys scattered around the airfield, serving as an excellent marker. On to Waterbeach, again on time at 16.17 hrs. and then a right turn taking us to the east of Cambridge for the last inter-display leg of the tour down to Biggin Hill.

This was a dog-leg via Chelmsford and Pitsea crossing the Thames between Grays and Tilbury, for which 20 min. was allowed. The airfield was easily identified not only by its prominent situation but also by the black mass of vehicles and people packed into a relatively small area. For our solitary pass the circuit was cleared of jet traffic—of which there appeared to be plenty.

Our track was now south to Beachy Head followed by a right turn along the coast past the sunlit harbours of Newhaven and Shoreham, then inland between Ford and Bognor Regis. A glimpse of the C.F.S. Jet Provost team performing at Tangmere was our last encounter with displays for the day.—R.S.H.

Photographs copyright "The Aeroplane and Astronautics"

MEN AND MACHINE.—Above, the Britannia crew, (l. to r.), Flt. Lt. B. D. Weatherley (navigator); Wg. Cdr. W. E. F. Gray, A.F.C. (captain); Flg. Off. P. M. Hill (co-pilot); Master Engineer F. Haigh (flight engineer) and Sgt. P. E. Ludbrook (air quartermaster). Missing is Flt. Sgt. F. Ward (signaller). Right, "Canopus" at dispersal.

Studies in Alighting

Howard Levy photographs

Above upper, orthodox in every way, a U.S.N. Douglas AD-6 Skyraider "goes round again" after an approach to alight on the U.S.S. "Intrepid." Above lower, the variable-incidence wing of the Chance-Vought F8U-1E Crusader keeps the approach angle remarkably flat.

Right upper, an outstanding feature of the Douglas A4D-2 Skyhawk is its stalky undercarriage. Right lower, the Douglas F4D-1 Skyray touches down at a fairly high angle of attack.

Below, the U.S.N. carrier "Intrepid" has five squadrons which are equipped with Skyraiders, Skyhawks, Skyrays and Crusaders; it has an angled deck and steam catapult and is the oldest "attack" carrier in the U.S. Fleet.

Commercial Aviation Affairs

EUROPEAN TRAFFIC.—The 12 member airlines of the Air Research Bureau showed an average increase of 14% in passenger-miles for June, 1961, by comparison with the same month of 1960. Provisional July figures show an increase of 15%. Passenger-load factors were 57.7% (60.7% in 1960) for June and 59.6% (63.4%) for July. Average load factor for the 12 months up to June, 1961, inclusive, was 55.5%.

TRAINING ANNIVERSARY.—The first intake of cadets at the College of Air Training, Hamble, last week completed a year of work. Of the original 21 (plus 20 who joined on Oct. 27, 1960) 38 have stayed the course so far—a very good record. The second year's work will involve training up to C.P.L. and Instrument Rating standards. These cadets are due to join B.O.A.C. late next year; the first intake for B.E.A. (50 cadets) joined the College on Sept. 4.

LAP RUNWAYS CLOSED.—The No. 5 runway (10:28L, 11,000 ft.) at London (Heathrow) was closed on Sept. 18 for seven days for the installation of VGPI at the recently extended western end. The No. 1 runway (10:28R, 9,313 ft.) is to be closed for two months on Oct. 1, for planned maintenance.

MAJOR MERGER.—Last week (Sept. 14) the two principal French "independent" carriers, Union Aéromaritime de Transport and Transports Aériens Intercontinentaux, agreed in principle to a merger.

F-27F CERTIFICATED.—A type certificate for the Fairchild Stratos Corporation's F-27F was issued earlier this month. The certificate covers an increase in take-off weight to 39,400 lb. and of landing weight to 37,500 lb., with fuel capacity increases to give trans-continental range. Certification of the F-27G, with even longer range and a gross weight of 42,000 lb., is expected early in 1962 (see our issue of Jly. 20, p. 66).

ARRESTED 727?—According to George C. Prill and Harold Hoekstra of the F.A.A., who presented a paper at last week's Anglo-American Aeronautical Conference, one airline has specified the capability of arrested landing (using a tail hook and runway gear) for its Boeing 727s.

BOEINGS IN PROSPECT.—Trans Arabia Airways, the Kuwait carrier which operates a scheduled service between Kuwait and the Lebanon, has announced that it will put Boeing 720Bs into service next year. Route rights have been obtained for services to Zurich and London.

SST CONFERENCE.—The U.S. Federal Aviation Agency will hold an industry-Government airworthiness conference on technical problems associated with the supersonic transport on Dec. 5-6 in Washington. The discussions will be based on a report by the F.A.A. Supersonic Transport Committee, headed by Harold D. Hoekstra.

MARKET OFFER.—Nord-built Super Broussards are offered through the latest *Market Report* of Aviation Exchange. The price of the unpressurized MH 260 is quoted as $295,000 and of the pressurized MH 262 as $335,000, with deliveries in May, 1962, and April, 1963, respectively.

NO 707s FOR GHANA.—The sales agreement for the purchase by the Government of Ghana of two Boeing 707-420s for early delivery to Ghana Airways has been terminated because of financing difficulties. Negotiations may be reopened later.

EASTERN SHUTTLE.—Eastern Air Lines has doubled the frequency of its highly successful no-reservation services between New York and Washington and Boston and Washington. The service is now hourly on each route, with 23 Super Constellations wholly occupied (see our issue for Jne. 29).

U.S. DOMESTIC LOSS.—The Air Transport Association has reported that a loss of more than $13.5 million (£4.8 million) was returned by the major U.S. domestic trunk airlines during the first six months of 1961.

FAR EAST 880-M.—Swissair introduced the first of its two Convair 880-Ms on the Zurich-Tokyo run on Sept. 10. It completed the return journey in a flying time of 37 hr. (see our issue of Aug. 31, p. 225).

LUTON CUSTOMS.—On-call Customs facilities are to be available at Luton Airport, for both passengers and freight, for a further 12-month period, until Sept. 30, 1962.

ELECTRA ACCIDENT.—A Lockheed Electra of Northwest Airlines crashed immediately after take-off from O'Hare Airport, Chicago, on Sept. 17, killing the 31 passengers and crew of five. The accident was the fourth this month, and brought the total of passenger fatalities this year on scheduled services (see p. 394) to 698.

News About People

MASTER AIR PILOT.—The GAPAN Master Air Pilot Certificate has been awarded to Capt. G. D. Ingleton, a B.E.A. training and line captain.

DERRITRON ADVISER.—Gp. Capt. T. G. Mahaddie has joined the Derritron Electronics Group as aeronautical adviser with particular reference to ultrasonics, vibration and environmental engineering.

JOINING THE BOSTIK PEOPLE.—Dr. T. P. Hughes, a former head of the R.A.E. Farnborough chemistry department and also chief superintendent of its rocket propulsion department, has joined the B.B. Chemical Co. as joint assistant managing director. Since 1955 he has been with Tube Investments.

RESEARCH DIRECTOR.—Captain Maurice Luby, R.N. (retd.), has been appointed research director of High Duty Alloys, Ltd., a member of the Hawker Siddeley Group. He is a former vice-chairman and managing director of Rotax, Ltd.

DULLES MANAGER.—The F.A.A. has named Mr. William E. Cullinan to be manager of Dulles International Airport, which is to become operational in the autumn of 1962.

M. A. SNOWBALL.—We regret to announce the death of Michael Anthony Snowball, B.O.A.C.'s assistant general manager (South America). Mr. Snowball, who was only 46 years of age, joined B.S.A.A. from the R.A.F. in 1947 and in 1949, after B.S.A.A.'s merger with B.O.A.C., he was appointed area secretary, Americas. In 1954 he was appointed manager, Far East, and based in Hong Kong.

VETERAN HANDOVER.—At Filton on Sept. 12 the Bulldog restored and rebuilt by Bristol Aircraft was handed over to the Shuttleworth Trust. The presentation to Air Cdre. A. H. Wheeler, Shuttleworth trustee (second left), was made by Mr. C. F. Uwins, deputy chairman of the Bristol Aeroplane Co. (centre). Also present were (l. to r.) Mr. J. F. Harper, Bristol Aircraft, Mr. R. L. Ninnes, Bristol Siddeley Engines and Mr. B. A. Chalmers, Bristol Aircraft.

Personal Flying

OVER 90 members of the Popular Flying Association made the journey to Fairwood Common airfield, Swansea, on Sept. 9 and 10 for the Association's two-day international rally. There was a turn-out of over 30 aircraft, including such interesting entries as a 1932 Comper Swift, which one of the joint owners, Mr. P. W. J. Stevenson, had flown from Sywell; a neat-looking Turbulent made by the Hertfordshire Experimental Group for £450; and a 1945 Stinson Reliant piloted by Mr. Owen Hill, Hampshire Aeroplane Club.

Mr. Norman Jones, of the Tiger Club, arrived in the prototype Condor to hear that he had been awarded the P.F.A.'s new Challenge Trophy, presented by the Royal Aero Club to the individual making the greatest contribution during the year to the cause of light aviation. The award for the best constructed ultra-light was won by the Hertfordshire Group.

The French were again strongly represented and Monsieur M. Beraud, president of the Réseau du Sport de L'Air, the French equivalent of the P.F.A., won the Concours d'Elegance trophy. Seven French entries flew to the Fairwood rally.

• • •

The first non-stop flight of a single-engined aircraft between Boston, Mass., and Manchester, took place on Sept. 13 when a four-seater Mooney Mk. 21 was delivered to Mercury Airlines, Ltd., Ringway. This company has been appointed North of England and Scottish concessionnaires for the Mooney.

Additional fuel tanks were installed in the cabin, giving a capacity of 138 gallons, of which about 100 gallons were actually used. The delivery pilot, Capt. Walter Moody, followed a great circle route of 2,732 nautical miles and the flight occupied 19 hr. 18 min.

• • •

The Russians are having their first opportunity of seeing a modern personal aeroplane with the current tour of the Soviet Union by a Cessna 172 Skyhawk, which is the World's most widely sold lightplane. After being shipped from New York to Russia, the Cessna Skyhawk is being shown in three major cities—Moscow, Stalingrad and Odessa—as part of an American travel exhibition. It is being displayed alongside a Ford Thunderbird sports car, a Buick engine, scale models of jet airliners and ships and other items.

The exhibition is scheduled to spend 21 days in each town, and is expected to attract 5-6,000 Russians per day. The best-selling Skyhawk holds the World's unofficial endurance record, having remained airborne at the beginning of 1959 continuously for 64 days, 22 hours and 19 minutes, around Las Vegas, Nevada.

Photograph copyright "The Aeroplane and Astronautics"

ITALIAN CONTENDER.—One of the most stimulating four-seat touring aeroplanes currently available is the Procaer F.15B Picchio, a flight report on which appears on p.400 of this issue.

Gliding Notes

by Dr. A. E. Slater

FOR 12 months past a gliding club has been operating in Cyprus, Gerald L. Kemp writes, using the R.A.F. airfield at Akrotiri. Under the leadership of Flt. Lt. Roy Salmon, the club began with a Kirby Cadet, with a Land-Rover for towing, using nylon rope. Then they bought a Tutor with spoilers from the Cambridge Club, and after that replaced the fuselage with a two-seater one, making it into a T-31. The club is now called "The Crusaders" and, since it began, has done over 2,000 launches, of which the T-31 has done 1,500. A Swallow is on order.

So far, six members have gone solo and one gained a "C" certificate in thermals. The thermal season is from September to March.

* * *

WEST WALES Gliding Association was represented by a keen nucleus of members in the hangar at Haverfordwest aerodrome on Sunday, Sept. 10, in spite of drizzle and low cloud giving no hope of any flying that day. The County Council, which owns the place, has allowed them space in a very fine hangar, quite impermeable to the depressing weather outside, both physically and psychologically.

For the use of this, and of the flying field, the Council charges the club £80 plus £2 per aircraft per year, so they pay £84, as the fleet consists of a T-21, bought new, and a Slingsby Swallow, which has had one year's use at Lasham. In addition, a private syndicate is being formed to buy something else.

Launching is by auto-tow with a Jaguar, which will usually pull the gliders up to 1,200 or 1,300 ft. There have been over 2,000 launches since January, and on a recent Sunday there were 86 in the day. Two cables are used, so that while one is doing a launch, the other is being retrieved by another car.

Starting with 60 founder members, the club had its biggest influx of new ones during the two-day Pembrokeshire Agricultural Show, which was held on a section of the aerodrome where the gliders "happened" to pass overhead.

The club's first cross-country was an attempted out-and-return flight to Milford Haven by Steve Chinnock and Rhoda Partridge in the T-21. They nearly made it, having to land on Haverfordwest racecourse on the way back. More cross-countries may be done in the coming week, when the Midland Club's Tiger Moth is being brought over for daily aero-towing duty.

* * *

WHEN Jim Grey, one of the instructors at the Haverfordwest club, heard I had come over from the Dale Fort Field Centre, he mentioned that he had a sea bird in his car, which must have been blown inland by the previous night's gale, and had pecked at the door of his house in the town at 22.00 hrs. It insisted on staying indoors, and refused to fly away next day. So he asked me to take it back to the Field Centre, where our bird migration expert, Ken Williamson, diagnosed it as a Manx Shearwater, almost certainly from Skokholm island, as it had a ring on its leg.

These birds will only come ashore at night, and this one probably mistook Jim Grey's house for a burrow. They dare not fly near a coast in daylight or even moonlight, or the nearest gull will pounce on them. But, once well out over the sea, they will soar wonderfully all day long just over the waves, and range as far as the Bay of Biscay.

The eyes of Shearwaters possess rather an odd feature. With our our human eyes, we can only see an object in clear detail by looking straight at it, so as to get its image focused on a small spot on the retina called the "fovea." Many birds have two foveas in the retina of each eye, one for looking forwards and the other for looking sideways. But the Shearwater has a fovea in the form of a horizontal line.

Why? The obvious reason is to enable the bird to see objects in detail all the way round the horizon—that is, when holding its head level. But when does it do so? Its soaring technique, from what I have read, consists of a continuous series of banked turns; and its enemies are likely to approach it from above, not at horizon level.

* * *

DALE FORT, where I am writing this, is said to be in the most westerly parish of Wales. We are on the steep northern slope of a narrow headland, and the southerly wind blowing up the other side for the last three days has produced a lee eddy with a strong northerly "slope wind" blowing up our side, at the top of which the gulls can be seen soaring with the odd appearance of facing the wrong way round.

There is room for 50 students, of whom about 15 are taking a course on "bird movements and weather," in charge of Dr. R. S. Scorer. As a relief from lectures, every now and then he takes us along the point and lets off smoke bombs in the lee eddy. He also gets us up at sunrise to watch the clouds from the hilltop.

Correspondence

New Home for the Schneider Trophy?

I SHOULD like to disagree most strongly with your correspondent, Mr. Ramsay, and his suggestion to remove the Schneider Trophy to the Royal Air Force Club. Whilst not wishing to decry the fine performances of Flt. Lt. Webster, Flg. Off. Waghorn and Flt. Lt. Boothman in the final three contests, I should like to point out that, according to the rules, this contest was a test of machine rather than of the pilot. If the Trophy should be moved anywhere, surely the logical custodians are Supermarine!

But since the Royal Aero Club, the R.A.F. Club and Supermarines are all places at which the Trophy would have a very limited audience, the best place for it is probably the Science Museum. There, together with the 1931 contest-winning S.6B, it would be displayed as a tribute to British engineering ability and would undoubtedly be seen by far more people than anywhere else.

Incidentally, lovers of art as well as engineering might like to study the Trophy, a very fine piece of work in bronze. Some estimate of the workmanship involved in its making may be gained from the fact that it was valued at £1,000 in 1913.

Slough, Bucks. JULIAN O. COOK.

A Shot in the Dark

IN his article "Lessons of Weightlessness" in your issue of August 31, "A.E.S." using his usual hypersensitive probe, has quite a bit to say about the eye and its known place as an interpreter for the mind. In astronautics we could perhaps carry further this interpretation aspect, bearing in mind that the eye is so very much older than the mind, and therefore conditions all interpretations to be within the mode and reason for the eye evolving at all.

In other words, mental interpretation, via the eye, is fixed permanently to the Earth! A little reflection on the heavy brow-ridge of early reptiles and man will make this a little easier to understand. In other words again, completely out of sight of the Earth, and its peculiar and insular reflecting properties, man might just as well be down an unlit coal mine.

Are we then, sir, quite sure that terrestrial mathematics must also be space mathematics? And the Venus probe literally a shot in the dark?

St. Albans. L. C. WRIGHT.

Russia's Venus Probe Orbit

THE close relationship between von Pirquet's suggested orbit of 1928 and the orbit of Russia's 1961 probe (THE AEROPLANE AND ASTRONAUTICS, Aug. 10, p. 157) is indeed remarkable. The combination of an included angle of 120° and a flight duration of 97 days appears to make the orbits identical. Russian space scientists have always been willing to study the publications of other nations, and there can be no doubt that they would be familiar with the works of von Pirquet.

It may, at first sight, seem to be puzzling that they have not acknowledged the adoption of the Austrian's suggested orbit, for it would be bound to come to light eventually that there was a close resemblance between the two. This, in fact, indicates that the situation is indeed a coincidence.

Inevitably, one examines the diagrams available for signs of differences. It will be seen that Russia launched her probe 57 days prior to Inferior Conjunction (at which Venus lies on the Earth-Sun line) whereas von Pirquet shows Inferior Conjunction (marked OK on his diagram) occurring about 49 days after launch. The major axis of the Russian probe orbit is at an angle of about 25° in advance of the Earth-Sun line at launch. The figure for the von Pirquet orbit is about 30°. The distance separating Earth and Venus when the probe is close to Venus is about 46 million miles in the case of the Russian probe, and about 41 million miles in von Pirquet's diagram.

The writer appreciates from his own experience that small differences in assumptions can often make large differences in results. Having regard to the fact that the orbits of the two planets are not strictly circular, and that they are inclined at a small but significant angle (about 3½°), the details of the transfer orbit would necessarily be different for each launching opportunity at 19 month intervals. When more information is made available on the basis of von Pirquet's calculations, it should be possible to say whether the differences noted are important.

The *Soviet News* translation of the *Pravda* article of Feb. 26 (I am quoting here from "Mission to Venus," *Spaceflight*, July, 1961) contains the following statements: "Suitable intervals between launching dates range from one to two months. One of these intervals fell at the end of 1960 and the beginning of 1961. This was utilized in the launching of Feb. 12." This shows that the launching occurred towards the end of the favourable period, a situation that engineers might feel to have been almost inevitable.

I'd like to be proved wrong, but for the sake of argument I am going to take the view that we are here faced with a most intriguing coincidence. Will someone please disagree?

Weston-super-Mare. S. W. GREENWOOD.

Groundabout

Farnborough Final

This year's S.B.A.C. flying display, fourteenth at Farnborough, was the most complicated yet and I really think the R.A.E. Air Traffic Controllers should get some kind of a medal for their work. The Navy have already expressed their appreciation by Navally entertaining Mac Pearson's boys on H.M.S. "Hermes." I'll donate this little sketch which I've had poised for some time to mark their record of emergency talk-downs during their normal operations.

*

Motoring home on Public Day: "What d'you think of Wessex 1 and Victor 2, dear?"

"Well, George—er—it sounds as though it was a very close game. . . ."

*

Geoffrey Dorman: "I think Farnborough should be in a permanent Le Bourget at Gatwick."

*

On the General Precision Systems stand, Norman Hill, sales director, showed me their intriguingly named Terravision visual flight simulator, which provides the pilot of a simulator with a moving picture of the outside scene. To paraphrase the old punning tag about *terra firma*, the more vision, the less the terra, whether simulated or actual. And, adapted to show entertaining films in passenger cabins, it would help to distract those of us who, knowing a little too much for our peace of mind, are inclined to brood during a hairy take-off or a prolonged let-down through rain—at night.

*

Hurdle Girdled. Speaking of let-downs seems a sort of logical lead-in to the *Sunday Telegraph's* news that B.E.A. are going to open "a Corset Jet service" to Madeira in December. B.U.A. and Silver City, who have also applied to operate to Madeira, are expected to counter with a two-way campaign to restrict further corporate expansion.

by Gren

Industry Record

Simulator Sale

Latest purchaser of the Solartron Electronic Group's fully transistorized radar simulator is the South African Department of Transport and Civil Aviation. This equipment is to be used for initial training and traffic evaluation in the surveillance rôle at Jan Smuts Airport, Johannesburg, and will provide synthetic targets on the airport radars.

Dual-purpose Lox System

The oxygen system for the DFS 582, a powered glider now being built in Germany for high-altitude meteorological research, is also to be used as a means of pressurizing the cockpit. This is disclosed by Normalair who are designing and developing the system which includes liquid oxygen storage equipment and supply-regulating units.

A two-fold function is, therefore, served by the system. It provides an oxygen enriched atmosphere in the cockpit—an arrangement necessitated by a design requirement that the pilot/observer shall not be encumbered by an oxygen mask, except in special or emergency conditions—and, as said before, cockpit pressurization.

A closed-circuit system for doing this was considered essential because the aircraft, after the shutting down of its 3,000-lb. thrust P. & W. JT12 turbojet at altitude, is intended to fly for long periods as a glider. Water vapour and carbon dioxide are extracted chemically from the cockpit air.

Basically, say Normalair, this system is identical to those which will be required for manned space vehicles. The first stage of its test programme has now been completed, flights of up to five hours having been simulated.

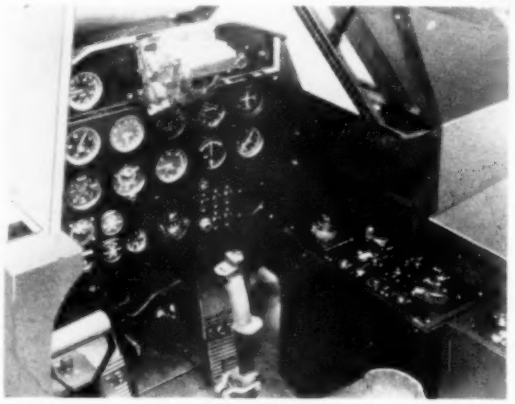
Also, Normalair tell us, they have produced a new range of oxygen equipment for the R.A.F.'s Gnat Trainers in which both the oxygen and radio-telephone circuits are combined. By providing the simultaneous connection of both circuits the risk of crews forgetting to couple-up their oxygen supply is eliminated.

Battery for the Light Types

Needs of the light and executive operator for replacement aircraft batteries are being met by Pritchett and Gold and E.P.S. Co., Ltd., who have introduced a new 12-v. lightweight addition to the Dagenite range. This unit, known as type EX, is particularly suitable for use with Piper and Cessna aircraft but can be applied, without modification, to most aircraft which come within this type category.

Main features of the new battery are a high strength moulded hard rubber container and cover, reinforced hold-down supports, and electrolyte level indicator moulded into the cover for easy servicing. It also has the proven high output plates and Porvic microporous separators usual in Dagenite batteries.

The EX battery has a 33-amp.-hr. capacity at the 5-hr. rate of discharge. It weighs 28 lb. charged.



LOW-PRICED FLIGHT SIMULATOR.—Two pictures of the first of Electronic Control Engineering's flight procedure trainers showing (left) the cockpit, designed in this case for jet trainer simulation, and the arrangement of the pilot's station and of the tracking/radio-aids and general control consoles. The instructor (above) can watch the cockpit instruments through a shielded glass panel. The equipment was described in last week's issue (p.347).

Vatric Expand

When the News of the World Organization took over the share capital of Vactric Control Equipment, Ltd., mention was made that it was planned to expand the company's facilities. Substantial premises at Garth Road, Morden, Surrey, have now been acquired and top priority is to be given to the building of a block for the development and applied research departments.

As additional space becomes available Vactric will gradually concentrate all its activities into this area. No change of address has yet been made.

Orpheus Award

Bristol Siddeley Engines' feature film, "The Orpheus Lightweight Turbojet," has been awarded a certificate of merit in a competition organized by the magazine *Industrial Screen* to find the most outstanding industrial films of 1961. This was the only entry from the aircraft industry to receive an award. Mr. G. L. Weinbren, films officer of Bristol Siddeley, received the certificate on Sept. 8.

Propeller Blades for the Transall

The de Havilland 18-ft.-diameter propellers specified for the three Franco-German C-160 Transall tactical transport prototypes will have the biggest die-forged aluminium blades yet to be made in this country. Of solid aluminium alloy, these are machined from forgings now being produced by Alcan Industries at its Handsworth, Birmingham, works on a 45,000-lb. forging hammer.

The blades begin life as extruded forging stock in Noral 17S alloy. Each stock is cylindrical in shape and measures 87 in. long with an 8½-in. diameter; its weight is 500 lb.

Prior to forging the stock is "scalped" to a diameter of 7½ in. and one end is machined to provide a tong hold. After soaking in a pre-heat furnace and being brought up to a temperature of 450° C. the stock receives the first of three part-stampings in the preparation dies of the forging hammer, alternated with intermediate pre-heats.

For the part-forged blade this sequence continues in the finishing dies after which the tong hold is removed and the hub machined. At this stage, blade dimensions are: length, 108 in., and maximum width, 19¾ in.

A further soaking in the pre-heat furnace takes place, after which the blade is placed in an upsetting press where the steel thrust rings are retained on the shank by an upset flange. This operation reduces blade length to 105 in. and is followed by solution heat treatment, trueing of the blade and finally polishing of the thrust rings. Weight of the blade on leaving the forge is 350 lb.

Each blade is machined to a maximum width of 18.4 in. by de Havillands, after which it is anodised.

Aviation Calendar

Sept. 21

London.—Industrial Painters Group incorporating the Society of Aviation Artists. Annual Exhibition at the Guildhall, E.C.2; until Oct. 7.

Sept. 22

Oxford.—Institute of Transport Weekend Conference; until Sept. 25.

Sept. 23

Munich.—Munich Flying Group Second Oktoberfest Rally; until Sept. 24.

Sept. 26

London.—Institute of Navigation and Electronic Engineering Association combined lecture. "The Transit Navigation Satellite System," by Dr. R. Kershner and Dr. R. Newton, at the R.G.S., Kensington Gore, S.W.7, at 10.00 hrs.

Sept. 28

London.—Science Museum lecture. "Astronomy including the Star Dome," at the Science Museum, Exhibition Road, S.W.7, at 15.15 hrs.

Oct. 4

Bristol.—Institution of Production Engineers and R.Ae.S. joint lecture. "Rocket Propulsion of Aerodynamics and Space Vehicles," by E. G. D. Andrews, at Bristol University, at 19.30 hrs.

London.—British Institute of Radio Engineers Electro-Acoustics Group lecture. "Methods Used for the Study of Vibration in Aero Engines," by D. A. Drew, at the London School of Hygiene and Tropical Medicine, W.C.1, at 18.00 hrs.

Oct. 5

Harrogate.—Aerodrome Owners Association Conference, at the Cairn Hotel; until Oct. 6.

Oct. 10

Birmingham.—Institute of Production Engineers, Midlands Section lecture. "Manufacturing Techniques of the Armstrong Whitworth Argosy," by R. A. Courtman and A. W. Menzies, at the James Watt Memorial Institute, at 19.00 hrs.

Company Notices

NEW COMPANIES

British Executive Air Services, Ltd. (701,984).—Private co. Reg. Aug. 30. Cap. £100 in £1 shrs. To acquire the undertaking of Pressed Steel Co., Ltd., carried on by its Air Services Division (exclusive of its Air Maintenance Section) and the undertaking of The Oxford Aviation Co., Ltd., and to enter into an agreement with the two said companies. To carry on the business of air transport contractors. Directors: Hugh D. H. Wills, Sandford Park, Sandford St. Martin, Oxon; Rex A. Smith, The Folly, Fringford, Nr. Bicester; John R. Henderson; Leonard Blount; Michael A. H. Bellhouse; Joseph R. Edwards; John K. Elliot; and John W. Gillespie. Sec.: L. Blount. Reg. off.: Oxford Airport, Kidlington, Oxon.

Management Aviation, Ltd. (702,061).—Private co. Reg. Aug. 30. Cap. £100 in £1 shrs. To carry on lines of aerial communication. Directors: William S. Dossett, 49 North Western Avenue, Kingsthorpe, Northampton; Michael Napier, Prince Regent Hotel, Cambridge. Sec.: William S. Dossett. Reg. off.: 19 Buckingham Street, W.C.2.

Personal Notices

BIRTHS

Hodgkinson.—On Aug. 25, at Catterick Military Hospital, to Maureen, wife of Flt. Lt. W. J. Hodgkinson—a daughter.

Hogg.—On Aug. 24, to Patricia (*née* Croft), wife of Sqn. Ldr. R. S. Hogg—a daughter.

Parr.—On Sept. 6, at R.A.F. Hospital, Ely, to Mary (*née* Barker), wife of Flg. Off. J. Parr—a son.

Simpson.—On Aug. 28, at R.A.F. Nocton Hall, to Valerie (*née* Day), wife of Flt. Lt. W. D. Simpson—a son.

Turnbull.—On Sept. 6, at the Louise Margaret Hospital, Aldershot, to Hazel (*née* Tarrant), wife of Wg. Cdr. G. Turnbull—a son.

ROLLS-ROYCE

offer further new engineering appointments in SCOTLAND

Caravelles of United Airlines of the U.S.A. are powered by Rolls-Royce Scottish-built Avon Engines.

EXPANSION IN SCOTLAND

Expansion in Scotland of Rolls-Royce Aero Engine Division Technical Services and a new design, development and experimental establishment lead to

IMMEDIATE VACANCIES FOR MECHANICAL ENGINEERS

with qualifications from H.N.C. to Honours degree in the following departments:

TECHNICAL SERVICES. Repair, Defect Investigation, Service and Liaison engineers.

QUALITY. Technical Production engineers.

DESIGN AND DEVELOPMENT. Engine Design and Development, Performance, Vibration, Fuel Systems, Mechanical Rig Test, Reheat and Stress Analysis engineers. Although a background of aero engine work would be an advantage in these posts applicants with a wide range of engineering experience may be suitable.

ACHIEVEMENTS. Rolls-Royce are leaders in civil and military gas turbine development. They have one of the largest research and development organisations in the world. Rolls-Royce engines power 55% of the gas turbine airliners in service or on order in the Western World. Behind these achievements is a team employing the most advanced engineering techniques.

A FUTURE

To maintain and improve its position in the aero engine industry Rolls-Royce needs engineers who are prepared to accept the challenge of these appointments. In eight years the overhaul life of the Dart, for instance, has been multiplied eight times to 3,200 hours while the take-off power has been doubled. Similar continuous development work goes on with all our other engines.

These appointments offer a secure and expanding future. If you would like to join this team which is an integral part of the Aero Engine Division of the Company, write to the address below.

Many Rolls-Royce people who have made their homes in the West of Scotland have found it has the most stimulating leisure activities. These include sailing, mountaineering, fishing, ski-ing and water ski-ing all within easy reach of Glasgow.

Write to the STAFF MANAGER · ROLLS-ROYCE LIMITED · HILLINGTON · GLASGOW · S.W.2

CLASSIFIED ADVERTISEMENTS

PRESS DAY: Classified Advertisements must normally be received at Head Office by FIRST POST THURSDAY for the following Thursday's issue. Last-minute additions and deletions are accepted by telephone from trade advertisers up to noon. Advertisements received too late for a particular issue are automatically inserted in the succeeding one unless instructions to the contrary are received.

RATES—1/- per word (minimum 12 words 12/-). Each paragraph charged separately and name and address must be paid for. Semi-displayed setting £3-17-6 per single column inch. Centred lines 22/6. Series discounts of 5% for 13, 10% for 26 and 15% for 52 consecutive insertions, allowed to trade advertisers.

TERMS—Strictly net and prepayable. Monthly accounts for settlement by the end of the month following insertion are allowed to trade advertisers if satisfactory references are provided.

REMITTANCES—Cheques and postal orders should be crossed and made payable to TEMPLE PRESS LIMITED and instructions sent addressed to the Manager, "The Aeroplane and Astronautics," Bowling Green Lane, London, E.C.1.

DEPOSIT SYSTEM—Facilities are available to readers to purchase advertised goods through "The Aeroplane and Astronautics." Commission 1% (minimum 2/-) on amount deposited.

BOX NUMBERS—Private advertisers desiring to have replies sent care of "The Aeroplane and Astronautics," may do so on payment of 1/- to cover booking and postage, plus cost of four extra words. Box Numbers must not be used for the purpose of circularizing and the Proprietors do not undertake the distribution of such matter received. To avoid mistakes in forwarding, Box Numbers should be carefully and legibly copied and replies sent to Box A000, care of "The Aeroplane and Astronautics," Bowling Green Lane, London, E.C.1.

THE PROPRIETORS retain the right to refuse or withdraw advertisements at their discretion and are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

HEAD OFFICES: Bowling Green Lane, London, E.C.1, England. Telephone: Terminus 3636. Telegrams: "Pressimus London Telex." Telex: 23839.

BRANCH OFFICES: Bayliss House, Hurst Street, Birmingham, 5. Telephone: Midland 6616. 50 Hertford Street, Coventry. Telephone: Coventry 27414. 1 Brazennose Street, Manchester. Telephone: Deansgate 6114–8. 12 Renfield Street, Glasgow. Telephone: Glasgow Central 1413.

30 YEARS EXPERIENCE & SERVICE

LIGHT AIRCRAFT

AUSTER AUTOCRAT. Cirrus Minor 2 engine with 378 hours since complete overhaul. Private C. of A. until 20th July 1962. Colour scheme pale blue and maroon with red leather upholstery. The Autocrat is an ideal light aeroplane for private or club use, particularly for those recently qualified who are anxious to build up flying hours as cheaply as possible. A good investment too, for Autocrats have held their price for several years now. Subject to remaining unsold—**£795**

CESSNA 172. This is an exceptional aeroplane, only 140 hours since new in 1960 and now offered at well over £1,000 less than list price. Beautifully finished in white and green, this all-metal aeroplane, which has been internal corrosion proofed against the vagaries of the English climate, is one of the best examples of American styling. Equipment includes dual control, blind flying panel, starter, navigation lights, battery, generator and cabin heating. Available in ten days with a new 2 year C. of A. at **$3,650** or **$4,185** including wheel fairings and King kY 99 VHF.

NEW OR USED AIRCRAFT SUPPLIED

TRANSPORT AIRCRAFT

VICKERS VISCOUNTS. Two late 700 Series Viscounts can be offered for charter from November 1961, and three other early 700 Series aircraft are available for sale now. Other Viscounts, both 700 and 800 Series are presently under option. Further details on request.

CESSNA 172

CREDIT TERMS ARRANGED

EXECUTIVE AIRCRAFT

PIPER APACHE MODEL "G." A brand new aeroplane with only delivery time on airframe and engines. Lycoming 160 h.p. engines and Hartzell propellers. Superbly equipped with Collins VHF and King VHF Standby, Collins VOR ILS including glide slope, fan marker receiver and ARC ADF, all Class I radio. Available for immediate delivery.

BEECH DEBONAIR. A 1960 demonstration model with just 100 hours since new. Fitted with a Continental 225 h.p. engine, the Debonair is one of the newest aircraft to be built by Beechcraft. It offers speed, equipment, superb construction, and good looks.
This particular model has duplicated VHF and RDF and is available immediately at a large reduction off list price.

PART EXCHANGE WITH OTHER AIRCRAFT OR CARS

SHACKLETON AVIATION LIMITED | 175 PICCADILLY, LONDON, W.1 HYDE PARK 2448/9

EUROPE'S LEADING AIRCRAFT TRADERS

TELEPHONE:
Monday—Friday, 9 a.m. to 6 p.m.
Saturday —— 9 a.m. to 1 p.m.
HYDE PARK 2448 9
Evenings and Weekends:
ELSTREE 1979
Cables:
SHACKHUD LONDON W1

AIRCRAFT FOR SALE

R. K. DUNDAS AERO. LTD.,

CAN BUSINESS EXECUTIVES AFFORD TO IGNORE THIS OFFER?

AUTOFLITE Aztec, as new, 180 hr., T.T., for £7,000 below list price!

THIS beautiful aircraft, blue and white, virtually like a new one, has full Super Custom instrumentation and radio, and is the cream of our current collection. We pride ourselves on producing many excellent offers, but cannot recall ever having one to match this, offered with British C. of A., U.K. duty paid, for £18,915—or £15,960 to Western Europe.

IF it's the cheapest, but still sturdy and very reliable aircraft you seek for similar carriage, then consider this fine

D.H. Rapide for only £1,000. 280 hrs. s.c.o.h. on engine, STR.9Z 100, 44 ch.ADF and radio compass. Fan Mkr. receiver, full I.F. panel, interior white, silver and blue, exterior red and grey, radio installed this year at a cost of £1,500.

R. K. DUNDAS AERO. LTD.,

DUNDAS HOUSE,
59 ST. JAMES'S STREET,
LONDON, S.W.1.
Phone: Hyde Park 3717. Cables: Dundusk. 605-10

PIPER aircraft on view, cars taken in part-ex/hanger. Terms. Maidenhead Autos, Bath Rd., Taplow, Maidenhead 4988. zzz-801

AUSTER Taylorcraft Plus D, the ideal group aeroplane, one year to run C. of A., 200 hours on engine, £575 o.n.o. Phone, Mr. Hercus, Welwyn Garden 26211 between 9.30 and 6.00. Based Panshanger. 605-2

CESSNA 180, 1957, 480 hours total. Fitted cross wind landing gear. Full panel dual control, together with Narco 27 Simplexer and MK. 2 V.O.R. New C. of A. Distinctive in ivory, gold and black. Phone, Jack Brabham, Elmbridge 4808-9280; Elmbridge 9749, evenings. 605-5

AUSTER V with low hours and three-year C. of A., new full blind-flying panel and many extras, for immediate sale. £1,600 o.n.o. Send for full specification list to Photopia, Ltd., Newcastle, Staffs. 605-8

RAPIDE, Gipsy Queen III engines, 460 and 527 hrs. since overhaul, 1,000 hr. life, public transport C. of A. until June 28, 1962, eight passenger seats, Murphy MR 100 V.H.F., Bendix compass and fan marker. Marshall, The Aerodrome, Christchurch, Hants. Phone 1689. 606-x7353

B.A. Swallow, perfect condition, one year unexpired C. of A. further 600 hours engine life, recently repainted, £450 o.n.o. D. Bernard, 156 Eastcote Rd., Pinner, Middx. 605-x7388

I FLY PIPER

Sole Distributors in the U.K.

VIGORS AVIATION LTD. OXFORD AIRPORT. KIDLINGTON 3444

There is a JODEL for you.

Either the **AMBASSADEUR** 3 seater or the **MUSKETEER** 4—5 seater.

U.K. Agents:
ROLLASON AIRCRAFT & ENGINES LTD. REDHILL AIRPORT • • • SURREY
Telephone: NUTFIELD RIDGE 2212

The SKYLANE
Cessna
APPOINTED DEALERS

The North & West Midlands: Westair Limited, Squires Gate Airport, Blackpool, Lancs.
East Anglia & East Midlands: W. H. & J. Rogers (Engineers) Ltd., Gt. Barford, Bedford.
West: Steels (Aviation) Limited, Clifton, Bristol.
Scotland: Airwork Services Limited, Perth Aerodrome, Perth, Scotland.

SOLE DISTRIBUTORS IN GREAT BRITAIN ARE
AIRWORK SERVICES
PANSHANGER AERODROME · HERTFORD
TELEPHONE: ESSENDON 111

TIGER MOTH with new 12 months' Certificate of Airworthiness, only 150 hours gone on engine, very good aeroplane, £550 o.n.o. Box A051, care of THE AEROPLANE AND ASTRONAUTICS. 605-x7387

AIRCRAFT ACCESSORIES, SPARES AND COMPONENTS

PHILLIPS AND WHITE, LTD.

THE leading stockists in the U.K. for instruments, navigational equipment, electrical components and parts, and engines accessories. Spares for de Havilland Gipsy Major and Queens series and Armstrong Siddeley Cheetah IX and XV engines.

61 QUEENS GARDENS, London, W.2. Phone, Ambassador 8651, 2764. Cables, "Gyrair London." zzz-772

THE REGIONAL AIR TRADING CO., Croydon Airport, for Rapide spares of every description. Phone, Croydon 8521. zzz-798

SURPLUS test equipment for sale. Hydraulic pneumatic vacuum, electrical, low temperature, instrument, propeller, tensile, impact, creep, crack detection, etc. Send requirements. L. Solloman, Ltd., 1 Beaufort St., Manchester, 3. Phone, Blackfriars 4571. 609-634

AIRFRAME spares for Dakotas, Harvards, Piper Cub, Fairchild, Argus, Beechcraft, DH'8, Mosquito, Spitfire, Firefly. Engine spares for Pratt & Whitney, Armstrong Siddeley, Lycoming, etc.; accessories and instruments for all types of aircraft.

C.47 Dakota operators please note, we offer a limited number of genuine brand-new Bendix 52058 tail wheels at a reasonable price.

A. J. WALTER, LTD., The Drive, Horley, Surrey. Phone, Horley 1420 and 4294. Cables, "Cubeng Horley." 605-6

CONSULTANTS

IAN L. S. McNICOL, London School of Air Navigation. Pilot and navigator training with advisory service. 33 Ovington Square, Knightsbridge, S.W.3. Ken 8221. zzz-791

R. W. SUTTON (CONSULTANTS), LTD., 7 Lansdowne Place, Cheltenham. Phone 5811. 614-663

ENGINES AND ENGINE SPARES

NEW Gipsy Major Series I and new Warner Super Scarab 165 h.p. engines available ex stock, C.I.F.E. nearest port, £860 sterling each.

LARGE quantities of Pratt & Whitney 1340-S1H1G complete power units condition as removed from aircraft inhibited. Prices on application.

WANTED. Cirrus engines and spares.

KINGSFORD SMITH AVIATION SERVICE, P.O. Box 55, Bankstown, Sydney. Cables: Kingsmith 605-7

BRITISH
WIRE THREAD INSERTS

Precision made in Carbon Steel for Aluminium and Magnesium. Also in Stainless Steel and Bronze.

B.S.F. · Metric · B.S.P. · B.A.
Whitworth · Unified

CROSS MANUFACTURING CO. (1938) LTD
COMBE DOWN · BATH · SOMERSET
Phone: COMBE DOWN 2359/8 Grams: CIRCLE BATH

Oxygen or Air Bottle Trolleys

A.M. Pattern complete with regulator, hoses, on pneumatic tyred trailer. Cost approx. £350. Our price £149. Ex stock.

Ex Stock ! ! ! No Waiting ! ! !

STARAVIA LTD.

Redfields Works Church Crookham, Nr. Aldershot, Hants.
Tel.: FLEET 1383

Southend Municipal Flying School

offers comprehensive training (day and night) for commercial and private pilots in the environment of an international airport. No entrance fees. Airport Club available to members.

Austers £4.5s. solo: £4.15s. dual; contract rate £4. Chipmunk £5.10s. dual or solo.

Municipal Airport, Southend-on-Sea, Essex
Phone: Southend-on-Sea 40201

THE BRITISH AIRLINE PILOTS ASSOCIATION
81, New Road, Harlington, Middx. *Tel. HAYes 3442/3*

Membership open to all Commercial and Service Pilots. For full details as to Objects and particulars of Membership, please write to General Secretary.

MINISTRY OF AVIATION

AIR TRAFFIC CONTROL OFFICERS

Posts for men or women at least 23 and under 35 on 1/7/61. Candidates must have had recent aircrew experience, preferably as pilot or navigator in civil air transport or H.M. Forces; but exceptionally, extensive experience in A.T.C.O. duties may be accepted. They should normally also have G.C.E. with five passes, or an equivalent academic qualification. Starting salary (London) from £872 to £1,251. Maximum £1,599. Appointment initially unestablished, but prospects of establishment and promotion.

Apply:

MINISTRY OF AVIATION
EST 5(a) 1/R 758, THE ADELPHI
JOHN ADAM STREET, LONDON, W.C.2

CLOTHING

R.A.F. Officers' uniforms, for sale, new and reconditioned. Fisher's, 86-88 Wellington St., Woolwich. Phone 1055. Kits also purchased. *zzz-774*

PACKING AND SHIPPING

R. AND J. PARK, LTD., Dominion Works, Thames Rd., Chiswick, London, W.4. Phone: Chiswick 7761. Official packers and shippers to the aircraft industry. *zzz-0782*

RADIO AND RADAR

STR12D, STR9Z, STR9X, and most other British and American V.H.F. R.T. equipment always in stock. A.R.B.-approved design installations into any type of aircraft. A. J. Whitemore (Aeradio), Ltd., Biggin Hill Aerodrome, Kent. *zzz-781*

SITUATIONS VACANT

AIRFRAME fitters required for repair and overhaul of Ministry of Aviation aircraft. Ex R.N.A.S. or R.A.F. personnel preferred. 42-hour, 5-day week. Canteen facilities. Free transport from Kettering, Northampton, Bedford and St. Neots areas. Apply in person or by letter to Brooklands Aviation, Ltd., Little Staughton Aerodrome, nr. St. Neots, Hunts. Phone: Colmworth 333. 606-663

PILOTS URGENTLY WANTED

FOR AGRICULTURAL FLYING IN NEW ZEALAND.

Fares paid. Salary £2,000-£2,500 p.a. Minimum Qualifications:—Commercial Licence and preferably 500 hours in charge.

Apply:

BEVERLEY J. SNOOK,
TRANS GLOBAL AVIATION SUPPLY CO.,
338 KILBURN HIGH ROAD,
N.W.6.
Phone: Maida Vale 6815. 605-11

PLANNING Engineer required with knowledge of machined and sheet metal details. Apply stating experience, age and salary required to the Manager, Brooklands Aviation, Ltd., Battlocks Bosch, Moulton, Northampton. 605-664

THE HONG KONG AIRCRAFT ENGINEERING CO., LTD.

THE ABOVE COMPANY HAS A VACANCY FOR AN

AERONAUTICAL ENGINEER

OF OUTSTANDING TECHNICAL AND ADMINISTRATIVE ABILITY.

The appointment will be filled by the applicant whose qualifications will justify rapid advancement and a high salary with the generous allowances applicable to appointments in Hong Kong.

Only applicants who can comply with the following should apply.

1. Age between 32 and 38 years.
2. Wide experience of aircraft and engine overhaul and maintenance, not only from the practical but also from the managerial aspect. Particular attention will be given to candidates with experience of large modern aircraft such as Boeing 707, Britannia, Comet and DC-6.
3. Considerable administrative experience with an operator of the above or similar aircraft.
4. In receipt of a present salary of not less than £1,800 per annum.
5. Qualified for membership of the Royal Aeronautical Society.
6. Available for interview in the U.K. after September 25.

Applicants should apply in writing to:—

MATHESON AND CO., LTD.,
3 LOMBARD STREET, LONDON, E.C.3,

stating personal details and enclosing resume of employment to date, all of which will be treated in strict confidence.

This advertisement appeared in the "Daily Telegraph" in April, and "Flight" and THE AEROPLANE AND ASTRONAUTICS in May. 606-1

SPACE RESEARCH

Two Physicists (men or women) required as Experimental Officers (minimum age 26) for the Royal Aircraft Establishment's Space Research programme at (a) Aberporth, Cardiganshire and (b) Bramshott, near Farnborough, Hants. Quals.: Pass degree, H.N.C., Grad. Inst.P., or equiv. Applicants must be experienced in handling and use of precision mechanical instruments, have interest in astronomy, and ability to deal with simple electrical and electronic equipment. Work involves irregular hours and observations at any hour of night. The officers appointed will organize and carry out, with assistance, routine observations of artificial satellites with high precision photogrammetric equipment, including harmonization of observations with Universal Time to high accuracy. In addition, at Bramshott, they will assist in research and development of appropriate photogrammetric methods. Salary Range: £1,087-£1,336. Write to Mr. M. J. Lightbill, F.R.S., Director, R.A.E., Farnborough, Hants., quoting reference M.O.A. HC/2D/714. 605-3

. . . **Economic to buy**
. . . **Economic to fly**

the Continental
META-SOKOL

The light roomy 4-seater Executive Aircraft supplied with most comprehensive Standard Specifications including, Dual Control, Cabin Heating, Retractable Undercarriage, Variable Pitch Propeller, Fuel Injection, Built-in Engine Fire Extinguisher, Pitot Heater, Full Night Flying Equipment, 24 Volt Electrical System.

PLUS Full Blind Flying Panel
PLUS King KX 100 91 Channel V.H.F. with separate 100 channel receiver with V.O.R./I.L.S. Localizer Indicator all crystal controlled.

For only £5,800 delivery U.K. duty paid

META-SOKOL
The Finest Value in Executive Flying Today
Enquiries also welcomed for the Morava L200A and the Aero 145 twin.

SOLE U.K. AGENTS
PETER S. CLIFFORD & Co. Ltd.
Oxford Airport, Kidlington
Phone Kidlington 3355
Evenings and W/Ends Bletchington 392
in conjunction with G.C Edward Mole, U.K. Distributor.
World wide distributors OMNIPOL, PRAGUE

INTERPLANETARY FLIGHT

by A. C. Clarke, B.Sc., F.R.A.S.

Now available in a new, up-to-date and completely revised edition, INTERPLANETARY FLIGHT is both a lucid introduction to the new science of astronautics and an exciting survey of the possibilities and problems of space travel.

Recent spectacular developments in the field of astronautics, many of them accurately predicted by the author in the first edition, are now recorded in this new edition, which also contains a new chapter on Earth Satellites and Lunar Probes, new illustrations and a comprehensive index.

From reviews of the first edition:

"Remarkably comprehensive, exciting and persuasive."
—The Times Weekly

160 pp. Illustrated
Fabroleen Boards
2nd Edition $8\frac{1}{2} \times 5\frac{1}{2}$ *in.*
12s. 6d. net by post 13s. 4d.

TEMPLE PRESS BOOKS
BOWLING GREEN LANE · LONDON EC1

Situations Vacant—contd.

CALEDONIAN AIRWAYS (PRESTWICK), LTD. require licensed aircraft engineers with "A" and/or "C" licences covering DC7C aircraft. licensed engineers without DC7C will also be considered, based at Gatwick and Prestwick as Station Engineers. Starting salary of £1,200 minimum, depending upon experience. Please apply to D. H. Walter, Technical Director, Caledonian Airways (Prestwick), Ltd., 101 Victoria Rd., Horley 4446-7. 605-665

SOCIETY OF BRITISH AIRCRAFT CONSTRUCTORS. A vacancy exists for a technical officer to assist in the secretaryship and management of a range of technical committees with special reference to those serving metallic materials and production processes. Some familiarity with report writing or similar experience is desirable. Write, giving particulars, to the Technical Secretary, The Society of British Aircraft Constructors, Ltd., 29 King St., Saint James's, London, S.W.1. 605-9

BRITISH UNITED AIRWAYS

A vacancy exists for the position of

PASSENGER SALES MANAGER

Applicants for this position who should not be less than 30 years of age and must have held a similar position with an airline company at least at Regional level and should be well versed in modern planned selling principles and implementing them through an established Sales Force.

The successful applicant will be based initially in the West End, and later at London (Gatwick) Airport.

This is a tough assignment holding excellent prospects of satisfying advancement.

The commencing salary will be in the region of £1,750 P.A.

Applications giving full details of career to date should be addressed to :—

Manager Personnel Services, British United Airways, London (Gatwick) Airport, Horley, Surrey.

BAHAMAS AIRWAYS, LTD. (B.O.A.C. Associate) are seeking additional traffic and allied staff for their station at Nassau, and applications are invited from suitably qualified and experienced men for the following appointments:

STATION and traffic assistants. Experience in civil airline procedures, passenger and cargo-handling methods is essential for these appointments. In addition, the supervisory qualifications necessary for the duties of station duty officer will be carefully investigated in all applications. Starting salary in the range of £24 to £36 per week.

TRANSPORT officer, experienced in the supervision and economical deployment of a highly flexible transport fleet concerned with baggage and passenger handling and in miscellaneous company duty vehicles. A mechanical maintenance background is of considerable importance, and essential for the proper maintenance rostering procedures of various types of vehicles and static equipment. Starting salary £40 to £45 per week.

THESE appointments are permanent and pensionable with generous holidays and low income tax. Written application only, giving brief personal details and experience, should be addressed to: Personnel Manager, B.O.A.C. Associated Companies, Ltd., Airways Terminal, Buckingham Palace Rd., London, S.W.1. 606-666

TUITION

DENHAM LINK TRAINING CENTRE. D4 and CANT 18 Trainers. Instrument ratings, renewals and latest procedures for flights to any aerodrome in the world. 21s. an hour. Denham 3171. zzz-797

LEARN to fly. £37. Instructors' Licence and Instrument flying for £4 12s. 6d. Night flying £5 12s. 6d. per hour. Residence 6 gns. weekly. Specialized course for Commercial Pilot's Licence. Wiltshire School of Flying, Ltd., Thruxton Aerodrome (Andover Junction 1 hr. 15 min. from Waterloo), Hants. zzz-799

INSTRUMENT rating, contact the acknowledged experts for D4 Link and flying trainers in London and at Oxford Airport. Link Training Services, Ltd., Cobs Court, Carter Lane, Ludgate Hill, E.C.4. Phone, City 6043. 611-651

IMPERIAL COLLEGE,
DEPARTMENT OF AERONAUTICS.
Course of lectures on Astronautics will be given during Autumn and Spring terms on Thursday from 3-5 p.m., starting October 6, fee 10 guineas. Further details from Registrar.

IMPERIAL COLLEGE,
LONDON, S.W.7. 605-4

LONDON SCHOOL OF AIR NAVIGATION offers full-time personal coaching with home-study correspondence courses or combination of both for all aspects of professional pilot and navigator qualifications also P.P.L. Officially appointed Service Courses Scheme. 33 Ovington Square, Knightsbridge, London, S.W.3. Ken 8221. zzz-792

EXETER SCHOOL OF FLYING offers the least expensive and most comprehensive flying training available. We specialize in Commercial Pilot's training and Instructor's training and our private pilot's course is approved. Contract rates from £3 18s. 6d. Full Air Traffic Control. V.H.F. DF and 24-hr. Met. Service, radio-equipped aircraft, grass or runways, local accommodation from £3 10s.; airport £5 15s. 6d. Exeter Airport, Ltd., Exeter. Phone 67433. zzz-800

AVIGATION, LTD., provide full-time or postal tuition or a combination of these methods for M.C.A. Pilot-Navigator licences. Classroom instruction can be provided for A.R.B. General, certain specific types and performance schedule examinations. D4, Links. Phone, Rodney 8671. For details apply Avigation, Ltd., 30 Central Chambers, Ealing Broadway, London, W.5. Ealing 8949. zzz-771

SURREY AND KENT FLYING CLUB, Biggin Hill (BN9) 2255. M.o.A.-approved course. Tiger and Hornet Moths, Chipmunk and Prentice. Contract rates. Route 705, one hour from Victoria. 605-0761

BST *ARB Approved*

Aeronautical Co. Ltd.

C47 · DC-3 Specialists

Stockists of British and American A.G.S. and A.N. spares for all types of British and American aircraft, from Austers to Viscounts, from Pipers to DC-4s.

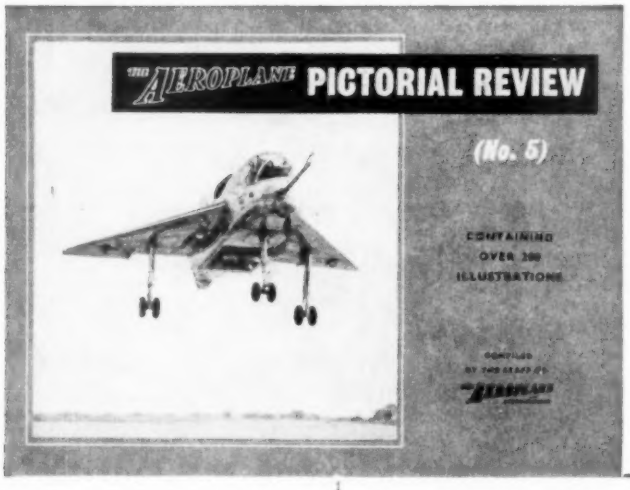
24 hour A.O.G. service operated, cable or telephone your requirements.

All enquiries handled by experts with many years' aviation experience. Alternatives can often be supplied from stock if original parts are not available.

Comprehensive stock list sent by return. Purchasing agents for foreign governments and overseas airlines.

84 ALEXANDRA ROAD, Farnborough · Hants

Telephone: Farnborough 2881/2/3.
Emergency: Guildford 66958
Cables: Bestair, Farnborough, Hants.



The Aviation Picture Book of the Year

THE AEROPLANE

PICTORIAL REVIEW (No. 5)

Containing over 200 illustrations selected for their striking quality and outstanding interest the current, Fifth Edition of this popular annual forms a unique pictorial record of the previous year's events in aviation throughout the world.

All the latest types of military and civil aircraft, in service and under development, are featured, including VTOL and STOL designs, naval aircraft, and helicopters large and small. There is a section reviewing the latest missiles and space vehicles and others portraying the newest type of light and executive aircraft and the highlights of the 1960 Farnborough Air Show.

Size: 7½ x 10 in. 128 pages
Over 200 illustrations
price 12s. 6d. net
(By post 13s. 7d.)

CONTENTS INCLUDE

New Shapes of 1960
Commercial Transport Aircraft
Light and Executive Aircraft
Missiles and Spaceflight
Fighters—Formation
Focus on Farnborough Air Display
Strategic Spearhead
For Aeronautical Development
Trainers and Transports
Rotary Wing Selection
Events of the Year

TEMPLE PRESS BOOKS: Bowling Green Lane, London, E.C.1.

Tuition—contd.

WHATEVER your training requirements, consult the organization that has 23 years' experience and has trained more than 14,000 pilots. There are a few vacancies remaining on a fully integrated flying and ground course for the C.P.L./I.R. starting on October 24, and our employment service is available to successful graduates. Prospectus and forms of application, from Air Schools, Ltd., The Aerodrome, Elstree, Herts. 605-12

BOOKS AND PUBLICATIONS

"CAMERA IN THE SKY," by Charles Sims, with a preface by Air Chief Marshal Sir James Robb. For more than 30 years Charles Sims, chief photographer of THE AEROPLANE AND ASTRONAUTICS and one of Britain's best-known aerial photographers, has watched the amazing growth of British aviation from a ring-side seat. In this book he recalls with pen and camera, enlivened with anecdotes, some of his many memories of those eventful days. Illustrated, 218 pages, 25s. net from booksellers, or 26s. 6d. by post from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1. zzz

"THE AEROPLANE" PICTORIAL REVIEW (No. 5). Staff of THE AEROPLANE AND ASTRONAUTICS. This fifth annual collection of outstanding aviation pictures contains over 200 photographs grouped in 12 sections and descriptively captioned. Illustrated, 128 pages, 12s. 6d. net from booksellers, or 13s. 7d. by post from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1. Other volumes available in this series: THE AEROPLANE Pictorial Review, No. 3, 10s. 6d. (post free, 11s. 7d.). THE AEROPLANE Pictorial Review, No. 4, 12s. 6d. net (post free, 13s. 7d.). All other volumes in this series are now out of print. zzz

"AEROPLANES AND AERO-ENGINES" (4th Edition). A new edition comprising 24 two- and three-page cutaway drawings which includes a variety of English civil and military aircraft and 10 piston-engine, jet and gas-turbine power plants. Illustrated, 56 pages, price 5s. net from booksellers, or 5s. 7d. by post from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1. zzz

INTERPLANETARY FLIGHT. An introduction to Astronautics (2nd Edition), by A. C. Clarke. Completely revised in the light of recent advances in the science of astronautics. Includes a chapter on earth satellites and lunar probes, and an appendix on fundamental theory and mathematical data. Illustrated, 152 pages, 12s. 6d. net from booksellers, or 13s. 4d. by post from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1. zzz

THE EXPLORATION OF SPACE (First Cheap Edition), by A. C. Clarke. Provides answers to the many questions the intelligent layman asks about the science of astronautics. Over 170,000 copies sold in all editions. Illustrated, 212 pages, 8s. 6d. net from booksellers, or 9s. 5d. by post from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1. zzz

MODERN AIRCRAFT DESIGN, by J. L. Naylor. Provides technicians in allied industries with an account of the wide background of knowledge behind the design of modern aircraft. Illustrated, 128 pages, 9s. 6d. net from booksellers, or 10s. 2d. by post from the publishers, Temple Press Limited, Bowling Green Lane, London, E.C.1. zzz

PRINCIPLES OF HELICOPTER ENGINEERING

BY JACOB SHAPIRO

This important work by a leading British authority on the design and construction of helicopters provides a complete survey of present knowledge in this field.

The approach is from the theoretical to the practical, in six chapters entitled: "Rotating Wings in Steady Flight"; "Performance of Helicopters"; "Dynamics of the Rotor"; "Mechanics of Helicopter Flight"; "Helicopter Projects" and "Rotorcraft Components and Assemblies."

In 448 pages of text, supplemented by 350 illustrations, a glossary of terms and a section devoted to notation, the author presents a comprehensive review of the engineering principles of helicopter design and construction.

Although written expressly for technicians, much of this work will prove of interest to the less technically-minded reader already attracted to this new and rapidly growing field of aeronautical development.

Royal 8vo. Cloth boards. Illustrated.

55s. net

Obtainable from all Booksellers or direct from the Publishers, postage 1s. 9d.

TEMPLE PRESS BOOKS

BOWLING GREEN LANE · LONDON EC1

WESTLAND HELICOPTERS

Training Scheme for DRAUGHTSMEN

A few places are available to join our next Drawing Office School this coming October. Candidates should possess O.N.C. or its equivalent, be between 21 and 30 years of age and have had several years' practical experience in engineering. After 20 weeks spent in our School the two-year course is completed by working on one of several interesting projects dealing with the design of rotary wing aircraft.

During the course full conditions of staff employment apply with progressive salary reviews.

Applications should be made in writing giving full details of experience and qualifications and sent to :—

The Personnel Manager,
FAIREY AVIATION LIMITED,
Hayes, Middx.

(Division of Westland Aircraft Limited)

CROSS PERFECT PRECISION AIRCRAFT SPRING WASHERS

TO B.S. SPECIFICATION 2 SP.47

CROSS MFG. CO. (1938) LTD

COMBE DOWN, BATH. Tel.: Combe Down 2355 S

BRITISH UNITED AIRWAYS

Invite applications for the position of

TRAFFIC MANAGER

To be based at London (Gatwick) Airport

Applicants must have had at least four years' experience in a senior capacity of aircraft passenger and freight handling requirements and possess a thorough knowledge of current techniques. He must have the ability to negotiate aircraft handling agreements and fully supervise staff training requirements.

This post carries a salary in the region of £1,350 P.A. and the successful applicant will be eligible to join the Company's Pension Scheme.

Applications giving full details of career to date should be addressed to :

Manager Personnel Services, British United Airways, London (Gatwick) Airport, Horley, Surrey.

TRAINING COURSES

for Viscount Aircraft

Now that Viscounts are appearing on the second-hand market, there is a growing need for training courses. Vickers-Armstrongs (Aircraft) Limited have therefore decided to organise a four weeks' general course for Airframe Engineers applicable to 700 series Viscount.

This course will commence on 30th October 1961

The fee for this training will be £10.10.0 per person per week

Should numbers warrant, a second course could be organised early 1962.

Applications to attend these courses should be sent to:-

The Manager,
Aircraft Servicing School,
Vickers-Armstrongs (Aircraft) Ltd.,
Weybridge, Surrey.

A COMPANY OF BRITISH AIRCRAFT CORPORATION

EXECUTIVE AIR TRANSPORT LIMITED

Applications are invited from

TECHNICAL MANAGERS

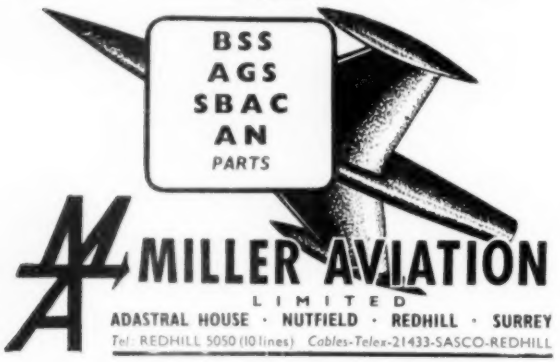
with high technical and administrative ability, for the setting up of an engineering base in the Midlands to be responsible for the complete organization and the engagement of suitable staff for maintenance on D.C.3., Heron and Dove Aircraft. A senior position will be offered to the successful applicant. Applications in writing should be addressed to:

The Secretary,
EXECUTIVE AIR TRANSPORT LIMITED
42-46 Hagley Road, Birmingham 16

AUTOMOTIVE PRODUCTS COMPANY LTD., Leamington Spa, Warwickshire
REGD. TRADE MARK 'PUROLATOR'

ONE OF THE AUTOMOTIVE PRODUCTS GROUP

A member of the group of companies



MILLER AVIATION LIMITED
ADASTRAL HOUSE · NUTFIELD · REDHILL · SURREY
Tel: REDHILL 5050 (10 lines) *Cables-Telex*-21433-SASCO-REDHILL

Precision Sheet Metal Workers and Light Engineers to the Aircraft Industry

Manufacturers of fabricated parts and assemblies in ferrous and non-ferrous metals. Tools, jigs and machined parts for the assemblies can be produced in our own workshops.

Let us quote for your requirements.

M.O.A. Approved D.G.I. No. 50037 *Fully Approved A.R.B. Ref. No. A1/2502/47*

C. W. FLETCHER & SONS LTD.
STERLING WORKS, ARUNDEL STREET, SHEFFIELD, 1

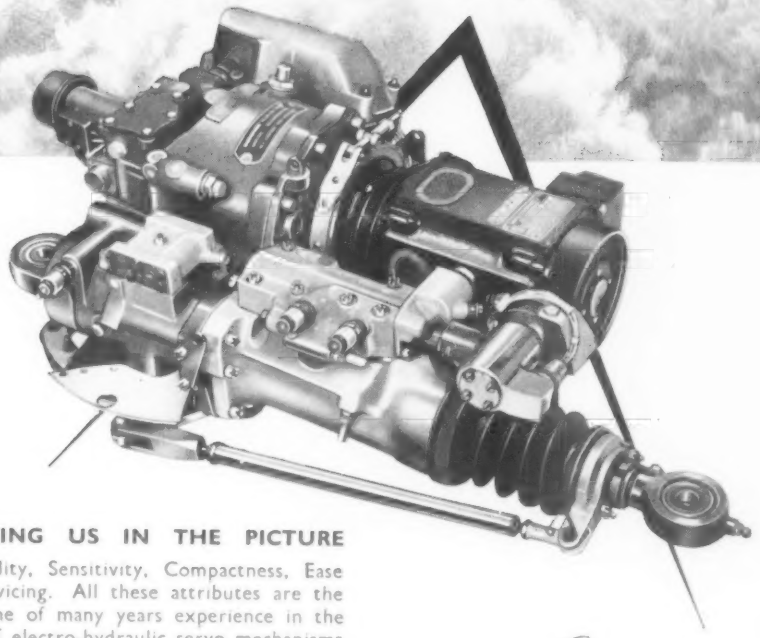
ALSO MORTIMER WORKS, MATILDA LANE, SHEFFIELD, 1

Telephone: Sheffield 28049 & 28040 ESTABLISHED 1891 Telegrams: Assayed Sheffield 1

INDEX TO ADVERTISERS

Name	Page
A	
Airwork Services, Ltd.	8
Automotive Products Co., Ltd.	12
B	
Boulton Paul Aircraft, Ltd.	Inside Back Cover
British Aircraft Corporation, Ltd.	11
British Airline Pilots Association	9
British Overseas Airways Corporation	2
British United Airways, Ltd.	10, 11
B.S.T. Aeronautical, Ltd.	11
Burnley Aircraft Products, Ltd.	1
C	
Clifford, Peter, & Co., Ltd.	9
Cross Manufacturing Co. (1938), Ltd.	9, 11
E	
Executive Air Transport, Ltd.	11
F	
Fletcher, C. W. & Sons, Ltd.	12
H	
Hawker Siddeley Aviation, Ltd.	2, 4, 5
K	
Keegan Aviation, Ltd.	9
M	
Miller Aviation, Ltd.	12
Ministry of Aviation	9
R	
Rollason Aircraft & Engines, Ltd.	8
Rolls-Royce, Ltd.	Front Cover, 7
Rotax, Ltd.	Back Cover
S	
Sangamo Weston, Ltd.	2
Shackleton Aviation, Ltd.	8
Short Brothers & Harland, Ltd.	3
Southend Municipal Flying School	9
Standard Telephones & Cables, Ltd.	Inside Front Cover
Staravia, Ltd.	9
V	
Vigors Aviation, Ltd.	8
W	
Westland Aircraft, Ltd.	6, 11

Printed in England and Published Weekly by the Proprietors, TEMPLE PRESS LIMITED, BOWLING GREEN LANE, LONDON, E.C.1.
Registered at the G.P.O. as a Newspaper. Second class postage paid at New York, N.Y. Registered for transmission to Canada and Newfoundland by magazine post. Annual Subscription Rate (Inland) United Kingdom 90/-, other countries 100/- (Canada and U.S.A. $13) postage included. Shorter periods pro rata. AGENTS ABROAD—EUROPE: Messageries Dawson (S.A.), Paris; Messageries Hachette (4 Cie.), Paris; W. H. Smith & Son, Paris and Brussels. CANADA—Wm. Dawson Subscription Service, Ltd., Toronto; Gordon & Gotch, Ltd., Toronto. U.S.A.—Eastern News Co., 306 West 11th Street, New York, 14, N.Y. AFRICA—Central News Agency, Ltd., Cape Town; Wm. Dawson & Sons (S.A.), Cape Town. ASIA—W. Thacker & Co., Ltd., P.O. 100, Bombay. AUSTRALIA and NEW ZEALAND—Gordon & Gotch (Asia), Ltd.



PUTTING US IN THE PICTURE

Reliability, Sensitivity, Compactness, Ease of Servicing. All these attributes are the outcome of many years experience in the field of electro-hydraulic servo mechanisms backed by nearly a million trouble-free flying hours with power control units of a similar type to that illustrated.

VICKERS V.C.10

Incorporating

POSITIVE, PRECISE, POWER CONTROLS

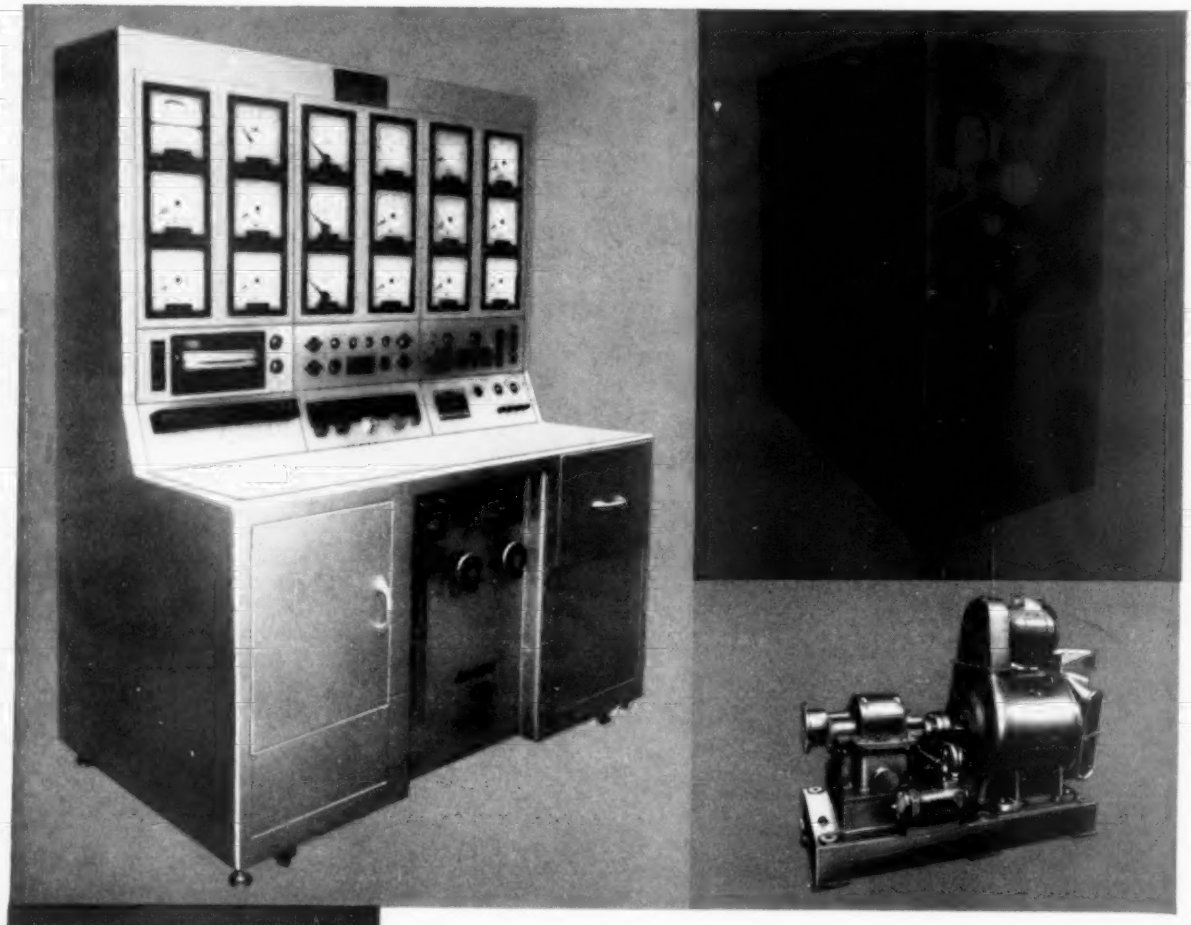
BOULTON PAUL AIRCRAFT LTD

MEMBER OF THE DOWTY GROUP

WOLVERHAMPTON · ENGLAND

ROTAX COMPLETE GENERATING TEST EQUIPMENT

Designed specifically for the overhaul of aircraft generating equipment, giving precision results over a wide speed range. Built for testing the generating systems of ELECTRA, VISCOUNT, BRITANNIA, FRIENDSHIP, ARGOSY, CARAVELLE AND VANGUARD AIRCRAFT.



ROTAX INDUSTRIAL GROUP

ROTAX LIMITED, WILLESDEN JUNCTION, LONDON, N.W.10. Tel: ELGar 7777